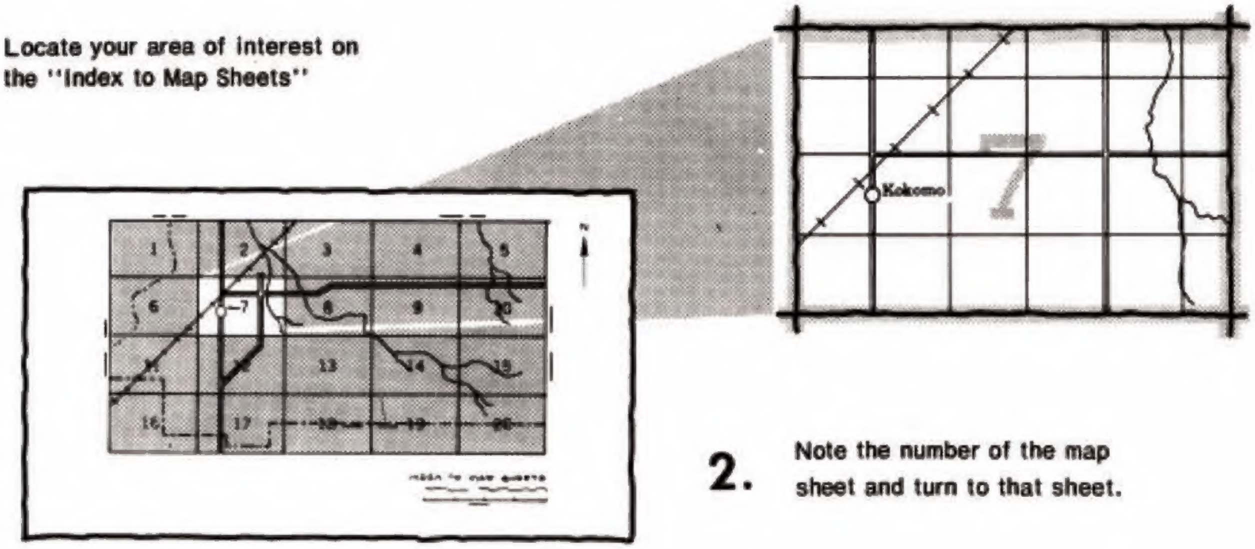
SOIL SURVEY OF

Buchanan County, Iowa

United States Department of Agriculture
Soil Conservation Service
in cooperation with
Iowa Agriculture and Home Economics Experiment Station and
Cooperative Extension Service, Iowa State University, and the
Department of Soil Conservation, State of Iowa

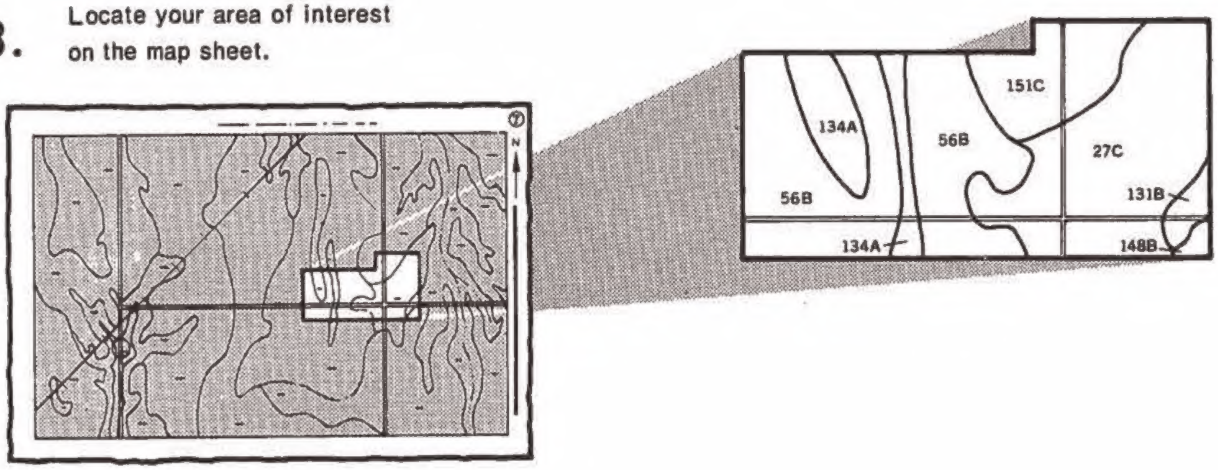
HOW TO USE

1. Locate your area of interest on the "Index to Map Sheets"



2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.



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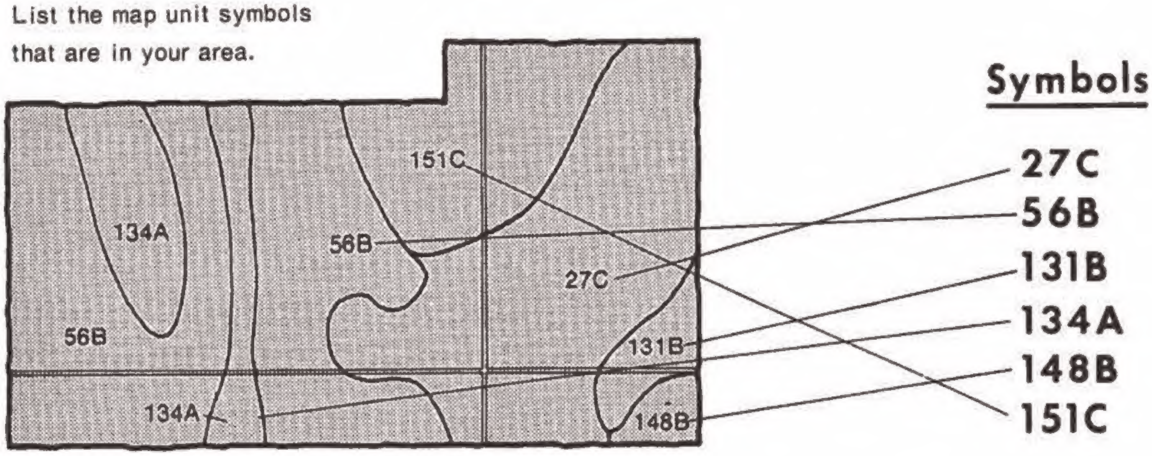
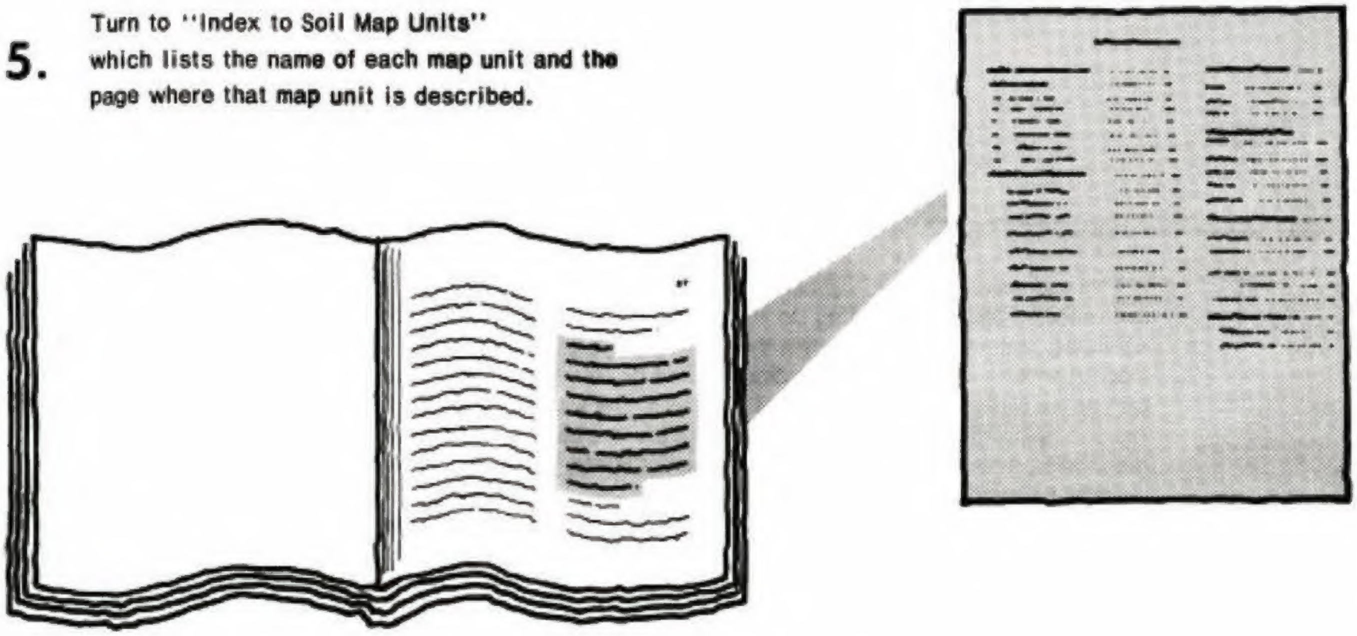
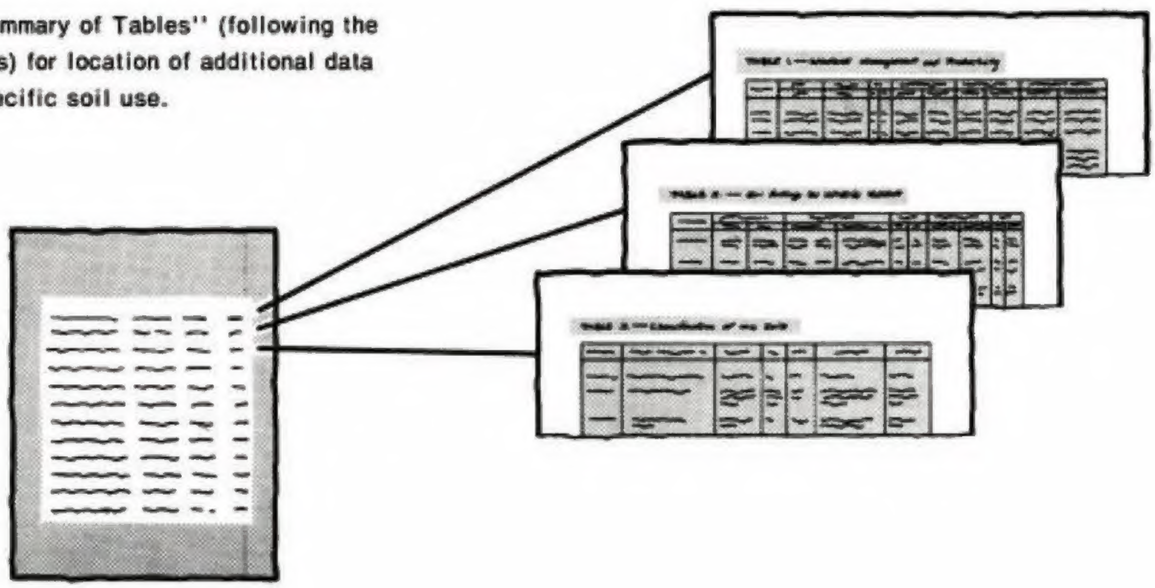


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; to specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

This survey was made cooperatively by the Soil Conservation Service and the Iowa Agriculture and Home Economics Experiment Station; the Cooperative Extension Service, Iowa State University; and the Department of Soil Conservation, State of Iowa. It is part of the technical assistance furnished to the Buchanan County Soil Conservation District. Funds appropriated by Buchanan County were used to defray part of the cost of the survey. Major fieldwork was performed in the period 1973-76. Soil names and descriptions were approved in 1978. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1978.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: Contour stripcropping on gently sloping Kenyon soils.

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soil series

Issued March 1982

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preface

This soil survey contains information that can be used in land-planning programs in Buchanan County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations inherent in the soil or hazards that adversely affect the soil, improvements needed to overcome the limitations or reduce the hazards, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

soil survey of
Buchanan County, Iowa

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Fieldwork by Mark J. Minger, Lyle L. Davis, Dale J. Ceolla,
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United States Department of Agriculture, Soil Conservation Service,
in cooperation with the Iowa Agriculture and Home Economics
Experiment Station; the Cooperative Extension Service, Iowa State University;
and the Department of Soil Conservation, State of Iowa

BUCHANAN COUNTY is in northeastern Iowa (fig. 1). It has a total area of 364,160 acres, or 569 square miles. It is about 25 miles east of Waterloo. Independence, the county seat, has a population of 5,910.

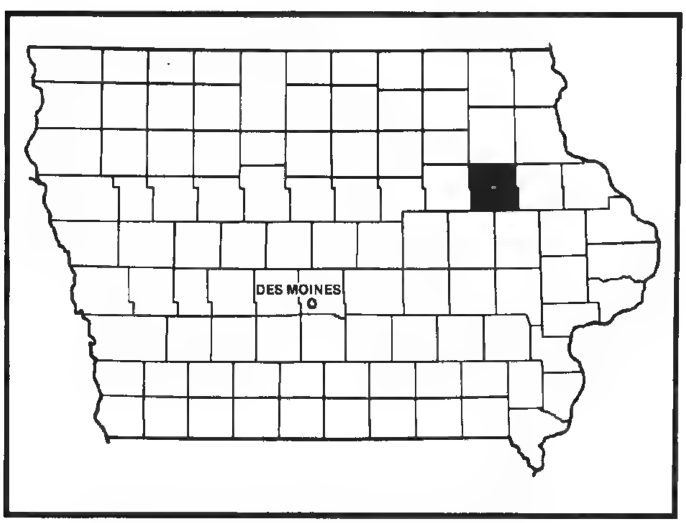

Figure 1.—Location of Buchanan County in Iowa.

Most of the acreage is farmland. Most of the cropland is used for corn and soybeans. Hogs are the principal livestock.

This survey updates the soil survey of Buchanan County published in 1926 (*3*). It provides additional information and larger maps, which show the soils in greater detail.

general nature of the county

The following paragraphs briefly describe the climate, relief and drainage, history and development, farming, transportation facilities, and natural resources of the county.

climate

Prepared by the National Climatic Center, Asheville, North Carolina.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Independence, Iowa, in the period 1951 to 1974. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 20 degrees F, and the average daily minimum temperature is 11 degrees. The lowest temperature on record, which occurred at Independence on March 1, 1962, is minus 30 degrees. In summer the average temperature is 70

degrees, and the average daily maximum temperature is 82 degrees. The highest recorded temperature, which occurred at Independence on July 30, 1955, is 102 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is about 33 inches. Of this, 24 inches, or 73 percent, usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 20 inches. The heaviest 1-day rainfall during the period of record was 5.16 inches at Indepencence on July 8, 1951. Thunderstorms occur on about 41 days each year, and most occur in summer.

Average seasonal snowfall is about 28 inches. The greatest snow depth at any one time during the period of record was 24 inches. On an average of 14 days, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 84 percent.

relief and drainage

Buchanan County is drained by the Wapsipinicon and Cedar Rivers and the South Fork of the Maquoketa River. The Wapsipinicon River, the principal stream in the county, flows from the northwest to the southeast. It drains about 65 percent of the county. Upstream from Independence, it meanders through a wide, flat valley that has distinct alluvial benches. Downstream from Independence, it is entrenched in limestone and the valley is narrow for several miles. The river becomes wider again and starts to meander before flowing into Linn County. It is about 940 feet above sea level where it enters the county on the west and 840 feet above sea level where it leaves the county on the south. The Cedar River flows only across the extreme southwest corner of the county, but its tributaries drain almost 25 percent of the county. The South Fork of the Maquoketa River drains about l0 percent, mainly the northeast corner.

On the north side of the Wapsipinicon River, most secondary streams flow south or southeast into the river. On the south side of the Wapsipinicon River, they are tributaries of the Cedar River and flow south or southwest. Most secondary streams are parallel to one another within their respective watersheds and are at right angles to the rivers into which they flow. Buffalo Creek enters from Fayette County and flows southeasterly across Buchanan County and small parts of Delaware and Linn Counties before draining into the Wapsipinicon River near Stone City, in Jones County.

The slope is 5 percent or less on about 98.6 percent of the acreage in the county. In most areas it conforms to the underlying glacial till. It generally is nearly level to gently rolling, but along the Wapsipinicon River it generally is hilly and steep. In several areas the valley walls are limestone cliffs. Elevations range from about 1,200 feet above sea level in the north-central part of the county to about 750 feet in the southwestern part.

history and development

The area that is now called Buchanan County was acquired from France as part of the Louisiana Purchase in 1803. In 1804, the United States negotiated a treaty with the Indians that prohibited white settlement west of the Mississippi River. This treaty was renewed in 1816. After 1819, the area was occupied principally by the Sauk and Fox Indian tribes of the Algonquin Indian Nation.

The east, west, and south boundaries were established in 1837, but the county was not officially opened to settlement until 1842. William Bennett was the first settler. On January 29, 1846, Iowa was admitted to the Union as the 29th state. By 1847, the 250 inhabitants of Buchanan County had elected their own officials and had assumed independent jurisdiction. By 1875, almost all of the land had been homesteaded and the population had grown to 18,315.

The early settlers generally came from New England and later from the Middle Atlantic Seaboard and the Ohio Valley. The Amish, who settled in the northwestern part of the county, started arriving in 1915. They are an important segment of the agricultural community. About 140 farm families in the county are Amish.

farming

The first settlers in Buchanan County were mainly farmers. The native vegetation was primarily tall prairie grasses. The problems of plowing up the dense sod, draining and fencing the land, and marketing the crops were very difficult.

The enactment of the Soil Conservation District legislation stirred the interest of many landowners in Buchanan County. The owners recognized the problems of water erosion, wind erosion, and the invasion of willows and noxious weeds caused by continuous cropping and inadequate soil drainage. The Buchanan Soil and Water Conservation District, the 79th soil conservation district in Iowa, was organized July 11, 1946.

In 1974, about 345,652 acres was farmland. The county had 1,607 farms, which averaged about 215 acres in size. Although the trend in recent years has been towards a decrease in the number of farms in the county, the size of individual farms generally has

increased. Cash grain farms far outnumber all other types, but some of the crops harvested are fed to the livestock on the farms where the crops are grown.

transportation facilities

Buchanan County is crisscrossed by hard-surfaced roads and highways. Access to market roads is available in all areas. U.S. Highway 20, running east and west, and Iowa Highway 150, running north and south, intersect at Independence. Airline transportation is available at Waterloo, in Black Hawk County, or at Cedar Rapids, in Linn County.

natural resources

Soil is the most important natural resource in the county. It provides a growing medium for the grass grazed by livestock and for cultivated crops. Other natural resources are limestone, gravel, sand, lumber, and glacial boulders.

Limestone is near the surface in several areas. It is used commercially for road building and concrete and as a source of lime for agronomic uses. Some limestone is used as decorative stone and flagstone.

The most extensive source of sand and gravel is the high alluvial terraces adjacent to the Wapsipinicon River. Some of the sand and gravel is in the uplands. Many of the upland areas are small and have not been mined for many years.

Native timber, generally in areas adjacent to the Cedar and Wapsipinicon Rivers, is used for crating and shipping manufactured products, for building construction, or as firewood.

Glacial deposits are a good source of boulders. Many of the existing buildings have foundations built with glacial boulders. Today, the boulders are used for commercial, community, or private landscaping. Rocks and boulders are commonly sold at garden centers and horticultural nurseries in nearby metropolitan areas.

how this survey was made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; and the kinds of rock. They dug many holes to study soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General soil map units" and "Detailed soil map units."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined management are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, woodland managers, engineers, planners, developers and builders, home buyers, and others.

general soil map units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

soil descriptions

1. Kenyon-Clyde-Floyd association

Nearly level to moderately sloping, moderately well drained to poorly drained, loamy soils on uplands

This association is on uplands characterized by long, gentle slopes, slightly convex divides, and a well developed network of wide, low gradient drainageways. Rounded granite stones and boulders formerly were common on the surface. Most have been removed so that the areas can be cultivated. Only a few areas remain unimproved.

This association makes up about 50 percent of the county. It is about 30 percent Kenyon soils, 20 percent Clyde soils, 10 percent Floyd soils, and 40 percent minor soils.

The moderately well drained Kenyon soils are the most extensive soils in the county. They are gently sloping on summits and divides and on long, smooth, convex side slopes and are moderately sloping on short, convex side slopes. The poorly drained, nearly level Clyde soils are in upland drainageways. Unimproved areas, where granite stones and boulders generally are on the surface, are pastured. The somewhat poorly drained, gently sloping Floyd soils generally are on concave foot slopes at intermediate elevations between the Kenyon and Clyde soils. The Clyde and Floyd soils have a seasonal high water table.

Typically, the surface layer of the Kenyon soils is very dark brown loam about 7 inches thick. The subsurface layer is very dark brown and very dark grayish brown loam about 13 inches thick. The subsoil is about 25 inches thick. The upper part is brown, friable loam, and the lower part is dark yellowish brown and yellowish brown, mottled, firm loam. The substratum to a depth of about 60 inches is mottled brown and grayish brown, firm loam.

Typically, the surface soil of the Clyde soils is black clay loam about 22 inches thick. The subsoil is about 38 inches thick. The upper part is dark gray, mottled, friable loam and grayish brown, mottled, very friable sandy loam; the next part is mottled yellowish brown and grayish brown, firm loam; and the lower part is dark yellowish brown, mottled, firm loam. The substratum to a depth of about 70 inches is dark yellowish brown, mottled, firm loam.

Typically, the surface layer of the Floyd soils is black loam about 12 inches thick. The subsurface layer is very dark grayish brown loam about 6 inches thick. The subsoil is about 40 inches thick. The upper part is dark grayish brown, mottled, friable loam; the next part is mottled brown, grayish brown, and yellowish brown, very friable sandy loam; and the lower part is mottled yellowish brown, brown, and grayish brown, firm loam. The substratum to a depth of about 60 inches is brown, mottled, firm loam.

Bassett, Olin, and Readlyn are the more extensive minor soils in this association. Less extensive are the Backbone, Bertram, Rockton, Sogn, and Whalan soils, which are underlain by limestone bedrock within a depth of 5 feet. The moderately well drained Bassett and well drained Olin soils are on convex ridges and side slopes. The somewhat poorly drained Readlyn soils are on plane or slightly convex slopes. The well drained Backbone, Bertram, Rockton, and Whalan soils are on convex side slopes below the Kenyon and Bassett soils. The somewhat excessively drained Sogn soils are on the lower parts of convex side slopes.

This association is used mainly for cultivated crops, but some small areas still support pasture plants or mixed hardwoods. If properly managed, most of the major soils are well suited to intensive row cropping. In

uncultivated areas the soils are mostly wet, steep, sandy, or rocky.

The principal management needs are improvement of drainage, control of erosion, and maintenance of tilth and fertility. The major soils formed in loamy sediments and the underlying firm loam glacial till. A stone line generally is at the contact between the loamy surficial sediments and the glacial till. Contour farming and terraces help to control erosion but tend to increase the wetness. As a result, a combination of drainage tile and terraces is needed.

2. Cresco-Clyde-Floyd association

Nearly level to gently sloping, moderately well drained to poorly drained, loamy soils on uplands

This association is on uplands characterized by long, gentle slopes, slightly convex divides, and a well developed network of wide, low gradient drainageways. Some of the highest elevations in the county are on the divides. Rounded granite stones and boulders formerly were common on the surface. Most have been removed so that the areas can be cultivated. Only a few areas remain unimproved.

This association makes up about 5 percent of the county. It is about 50 percent Cresco soils, 20 percent Clyde soils, 10 percent Floyd soils, and 20 percent minor soils.

The moderately well drained, gently sloping Cresco soils are on summits and divides and on long, smooth, convex side slopes. The poorly drained, nearly level Clyde soils are in upland drainageways. Unimproved areas, where granite stones and boulders generally are on the surface, are pastured. The somewhat poorly drained, gently sloping Floyd soils generally are on concave foot slopes at intermediate elevations between the Cresco and Clyde soils. All of the major soils have a seasonal high water table.

Typically, the surface layer of the Cresco soils is black loam about 6 inches thick. The subsurface layer is very dark gray and very dark grayish brown loam about 10 inches thick. The subsoil is about 41 inches thick. It is, in sequence downward, brown, friable loam; yellowish brown, firm loam; yellowish brown, very firm clay loam that has nearly continuous grayish brown coatings; mottled strong brown and yellowish brown, very firm clay loam that has thick, nearly continuous coatings; and mottled strong brown and yellowish brown, very firm clay loam that has thin, discontinuous coatings. The substratum to a depth of about 60 inches is mottled strong brown and yellowish brown clay loam.

Typically, the surface soil of the Clyde soils is black clay loam about 22 inches thick. The subsoil is about 38 inches thick. The upper part is dark gray, mottled, friable loam and grayish brown, mottled, very friable sandy loam; the next part is mottled yellowish brown and strong brown, firm loam; and the lower part is dark yellowish brown, mottled, firm loam. The substratum to a depth of about 60 inches is dark yellowish brown, mottled, firm loam.

Typically, the surface layer of the Floyd soils is black loam about 12 inches thick. The subsurface layer is very dark grayish brown loam about 6 inches thick. The subsoil is about 40 inches thick. The upper part is dark grayish brown, mottled, friable loam; the next part is mottled brown, grayish brown, and yellowish brown, very friable sandy loam; and the lower part is mottled yellowish brown, brown, and grayish brown, firm loam. The substratum to a depth of about 60 inches is brown, mottled, firm loam.

Minor in this association are the somewhat poorly drained Donnan and Protivin soils and the moderately well drained Kenyon soils. Donnan and Kenyon soils are on convex ridges and side slopes. Protivin soils are on plane or slightly concave side slopes.

This association is used mainly for cultivated crops. If properly managed, most of the major soils are well suited to intensive row cropping. In uncultivated areas the soils are mostly wet and rocky.

The principal management needs are improvement of drainage, control of erosion, and maintenance of tilth and fertility. The major soils formed in loamy sediments and in the underlying firm or very firm loam glacial till. Water moves more rapidly in the loamy surficial sediments than in the firm or very firm loam glacial till. It accumulates at the contact between the two materials and moves downslope along this contact until it emerges in a seepy area or a side slope or saturates the upper layers of the soils on the foot slopes or toe slopes. A stone line generally is at the contact between the loamy surficial sediments and the glacial till. Contour farming and terraces help to control erosion but tend to increase the wetness. As a result, a combination of drainage tile and terraces is needed.

3. Readlyn-Tripoli-Oran association

Nearly level and very gently sloping, somewhat poorly drained and poorly drained, loamy soils on uplands

This association is on uplands characterized by broad, nearly level divides that are cut by a few well defined drainageways. It makes up about 13 percent of the county. It is about 35 percent Readlyn soils, 20 percent Tripoli soils, 15 percent Oran soils, and 30 percent minor soils (fig. 2).

The somewhat poorly drained, very gently sloping Readlyn soils are on broad, slightly convex upland divides and are at slightly higher elevations than the Tripoli soils. The poorly drained, nearly level Tripoli soils are on broad, slightly concave upland divides or at the head of upland drainageways and are at a slightly lower elevation than the Readlyn and Oran soils. The somewhat poorly drained, very gently sloping Oran soils are in positions on the landscape similar to those of the

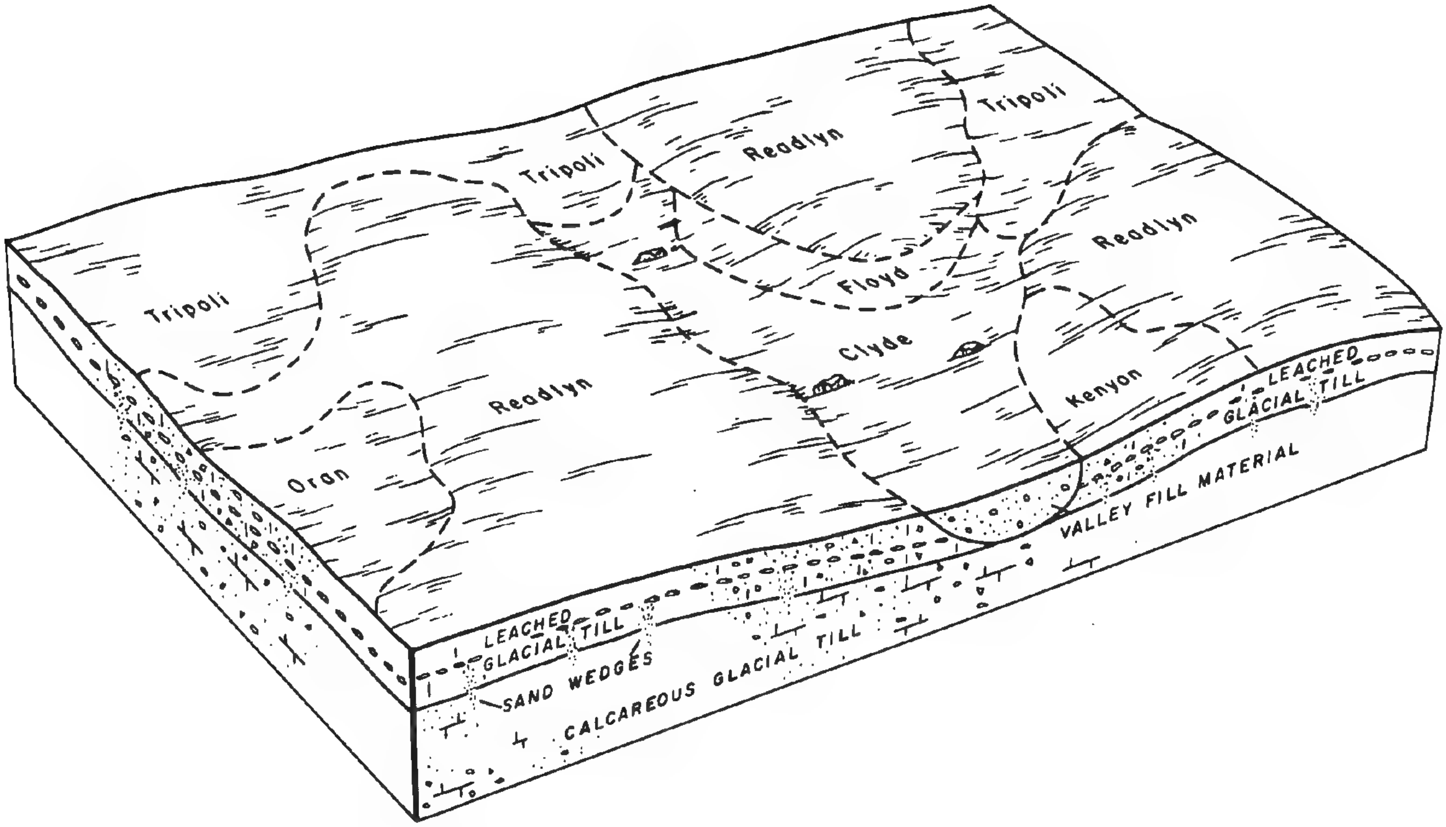

Figure 2.—Pattern of soils and parent material in the Readlyn-Tripoli-Oran association.

Readlyn soils. All of the major soils have a seasonal high water table.

Typically, the surface layer of the Readlyn soils is black loam about 8 inches thick. The subsurface layer is very dark brown and very dark grayish brown loam about 9 inches thick. The subsoil is about 33 inches thick. It is mottled. The upper part is dark grayish brown, friable loam, and the lower part is olive brown and light olive brown, firm loam. The substratum to a depth of about 60 inches is light olive brown loam.

Typically, the surface layer of the Tripoli soils is black clay loam about 8 inches thick. The subsurface layer is black clay loam about 11 inches thick. The subsoil is about 35 inches thick. It is mottled. The upper part is dark grayish brown, friable loam; the next part is light olive brown, firm loam; and the lower part is yellowish brown, strong brown, and grayish brown, firm, calcareous loam. The substratum to a depth of about 60 inches is mottled strong brown and grayish brown loam.

Typically, the surface layer of the Oran soils is very dark gray loam about 7 inches thick. The subsurface layer is dark grayish brown loam about 3 inches thick. The subsoil is about 46 inches thick. The upper part is brown and grayish brown, mottled, friable and firm loam; the next part is mottled strong brown and light brownish gray, firm loam; and the lower part is strong brown, mottled, firm loam. The substratum to a depth of about 60 inches is strong brown, mottled loam.

Minor in this association are the poorly drained Clyde soils, the somewhat poorly drained Floyd soils, the moderately well drained Kenyon soils, and the well drained Olin soils. Clyde soils are in drainageways. Floyd soils are on concave side slopes above the drainageways. Kenyon and Olin soils are on convex ridges and side slopes.

This association is used mainly for cultivated crops. Because most areas have been drained, the major soils are well suited to intensive row cropping. Wetness is the main limitation. Measures that maintain tilth and fertility are needed.

4. Klinger-Maxfield-Franklin association

Nearly level and very gently sloping, somewhat poorly drained and poorly drained, silty soils on uplands

This association is on uplands characterized by broad, nearly level divides that are cut by a few distinct drainageways. It makes up about 2 percent of the county. It is about 20 percent Klinger soils, 20 percent Maxfield soils, 15 percent Franklin soils, and 45 percent minor soils (fig. 3).

The somewhat poorly drained, very gently sloping Klinger soils are on broad, slightly convex upland divides and are at slightly higher elevations than the Maxfield soils. The poorly drained, nearly level Maxfield soils are on broad, slightly concave upland divides or at the head of upland drainageways and are at slightly lower elevations than the Klinger and Franklin soils. The somewhat poorly drained, very gently sloping Franklin soils are in positions on the landscape similar to those of the Klinger soils. All of the major soils have a seasonal high water table.

Typically, the surface layer of the Klinger soils is black silty clay loam about 7 inches thick. The subsurface layer is black silty clay loam about 6 inches thick. The subsoil is about 30 inches thick. The upper part is dark grayish brown and olive brown, mottled, friable silty clay loam; the next part is mottled grayish brown and strong brown, friable sandy loam; and the lower part is mottled grayish brown and yellowish brown, firm loam. The upper part of the substratum is mottled grayish brown, yellowish brown, and strong brown loam. The lower part to a depth of about 60 inches is yellowish brown, mottled loam.

Typically, the surface layer of the Maxfield soils is black silty clay loam about 7 inches thick. The subsurface layer is black and very dark gray silty clay loam about 11 inches thick. The subsoil is about 20 inches thick. It is mottled. The upper part is dark gray, friable silty clay loam; the next part is grayish brown, friable silt loam; and the lower part is grayish brown, firm loam. The substratum to a depth of about 60 inches is mottled grayish brown and yellowish brown, firm loam.

Typically, the surface layer of the Franklin soils is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is dark grayish brown and grayish brown silt loam about 6 inches thick. The subsoil is about 33 inches thick. The upper part is grayish brown, mottled, friable silty clay loam, and the lower part is mottled light brownish gray and yellowish brown, firm

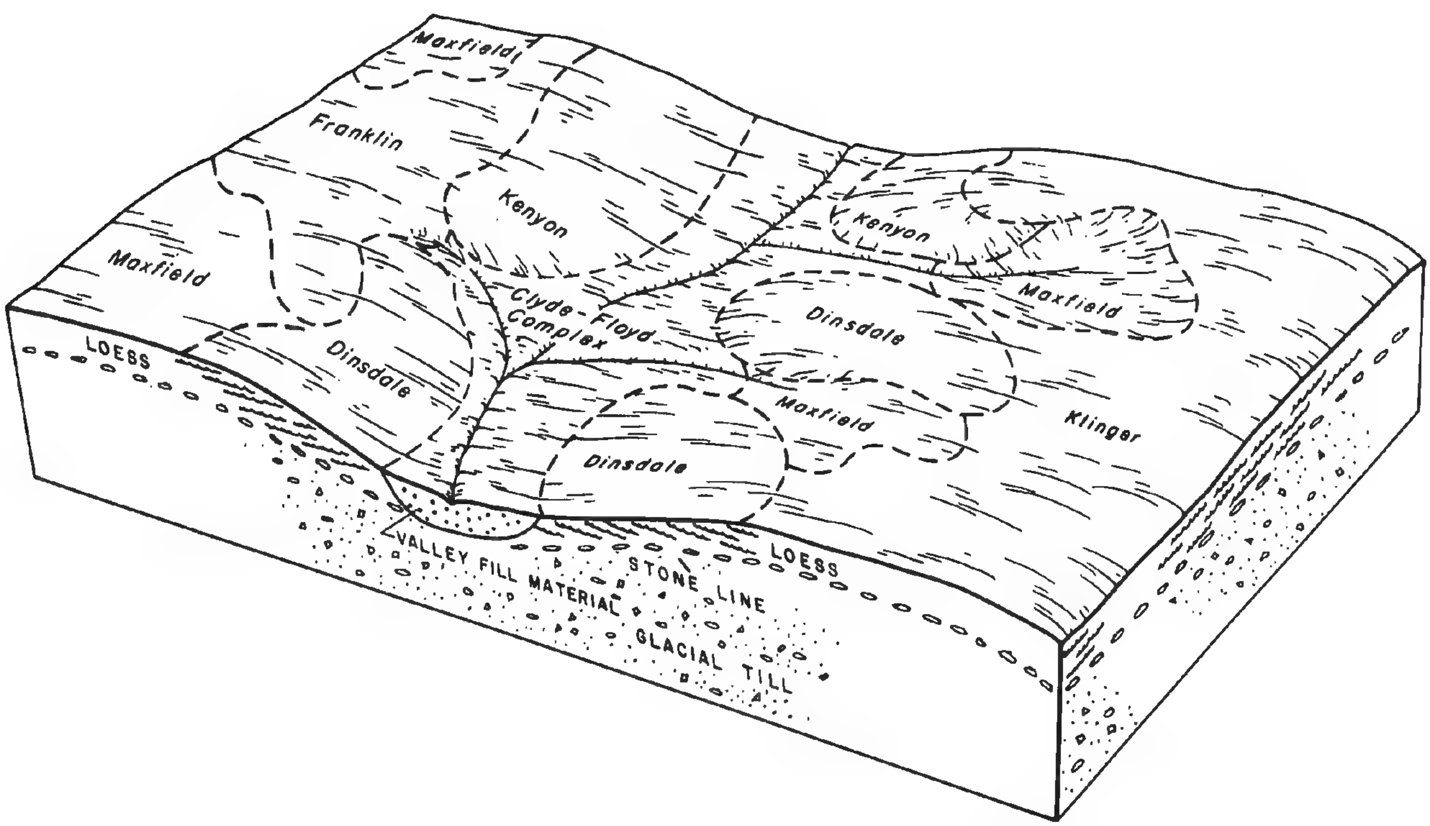

Figure 3.—Pattern of soils and parent material in the Klinger-Maxfield-Franklin association.

loam. The substratum to a depth of about 60 inches is mottled light brownish gray and yellowish brown loam.

Minor in this association are the poorly drained Clyde soils, the well drained Dinsdale soils, the somewhat poorly drained Floyd soils, and the moderately well drained Kenyon soils. Dinsdale and Kenyon soils are on convex ridges and side slopes. Clyde soils are in drainageways. Floyd soils are on concave side slopes above the drainageways.

This association is used mainly for cultivated crops. Because most areas have been drained, the major soils are well suited to intensive row cropping. Wetness is the main limitation. Measures that maintain tilth and fertility are needed.

5. Seaton association

Gently sloping to very steep, well drained, silty soils on uplands

This association is on uplands characterized by short, steep side slopes, by ridges, and by a well developed network of narrow, high gradient drainageways. Limestone is at or near the surface in some of the very steep areas.

This association makes up less than 1 percent of the county. It is about 50 percent Seaton soils and 50 percent minor soils.

The gently sloping to very steep Seaton soils primarily are on ridgetops and side slopes. In some areas, however, they are on isolated, steep, cone-shaped mounds that are surrounded by gently sloping glacial till plains. They are the only soils in Buchanan County that formed in deep loess.

Typically, the surface layer of the Seaton soils is dark grayish brown silt loam about 6 inches thick. The subsoil is about 44 inches of friable silt loam. The upper part is dark yellowish brown, the next part is dark yellowish brown and is mottled, and the lower part is yellowish brown and is mottled. The substratum to a depth of about 60 inches is dark yellowish brown, mottled, friable silt loam.

Minor in this association are the moderately well drained Bassett soils, the excessively drained Chelsea soils, and the well drained Lamont, Nordness, and Whalan soils. Bassett soils are on convex ridges and side slopes on glacial till plains below the Seaton soils. Chelsea and Lamont soils are on convex mounds on the till plains. Nordness and Whalan soils are on the lower parts of convex side slopes on the till plains.

About one-third of this association is used for cultivated crops and the rest for pasture and woodland. The gently sloping to strongly sloping soils are suitable for cultivated crops. The steeper soils are better suited to hay and pasture or to woodland. Some areas are becoming very popular as building sites because of the scenic beauty.

The soils are productive, but erosion is a hazard. Terracing and contour farming are not always feasible because the slopes commonly are short, steep, or irregular. Measures that maintain tilth and fertility are needed.

6. Olin-Sparta-Chelsea association

Nearly level to moderately sloping, well drained and excessively drained, loamy and sandy soils on uplands and stream benches

This association is on uplands or high alluvial benches characterized by short, gentle slopes, slightly convex summits or divides, and a network of low or medium gradient drainageways. Areas are long and narrow and generally are east or south of the major stream valleys.

This association makes up about 13 percent of the county. It is about 35 percent Olin soils, 23 percent Sparta soils, 9 percent Chelsea soils, and 33 percent minor soils.

The gently sloping and moderately sloping, well drained Olin soils are on convex summits or divides and side slopes in the uplands. The excessively drained Sparta and Chelsea soils are on convex summits, divides, and side slopes and on high alluvial benches. The Sparta soils are nearly level to moderately sloping, and the Chelsea soils are gently sloping and moderately sloping.

Typically, the surface layer of the Olin soils is very dark brown sandy loam about 7 inches thick. The subsurface layer is very dark brown and very dark grayish brown fine sandy loam about 14 inches thick. The subsoil is about 34 inches thick. The upper part is brown, very friable fine sandy loam; the next part is dark yellowish brown, firm loam; and the lower part is yellowish brown, mottled, firm loam. The substratum to a depth of about 60 inches is mottled yellowish brown and grayish brown loam.

Typically, the surface layer of the Sparta soils is very dark grayish brown loamy fine sand about 7 inches thick. The subsurface layer is very dark grayish brown and dark brown loamy fine sand about 17 inches thick. The subsoil is about 16 inches of very friable loamy fine sand. The upper part is brown, and the lower part is yellowish brown. The substratum to a depth of about 60 inches is yellowish brown, loose sand.

Typically, the surface layer of the Chelsea soils is very dark gray loamy fine sand about 5 inches thick. The subsurface layer is about 33 inches thick. The upper part is brown, very friable loamy fine sand, and the lower part is brown, loose fine sand. Below this to a depth of about 60 inches is brown fine sand that has bands of brown loamy fine sand 1/4 inch to 2 inches thick.

Minor in this association are the poorly drained Clyde soils, the somewhat excessively drained Dickinson soils, the moderately well drained Kenyon soils, and the well drained Lamont soils. Clyde soils are in upland

drainageways. Dickinson, Kenyon, and Lamont soils are on convex ridges and side slopes in the uplands.

Many of the nearly level and gently sloping areas are used for crops. A large percentage of the moderately sloping areas are used as pasture, woodland, and wildlife habitat. Drought and erosion are the main hazards. Measures that maintain tilth and fertility are needed.

7. Spillville-Coland-Marshan association

Nearly level, moderately well drained to poorly drained, loamy soils on flood plains and low stream benches

This association is characterized by nearly level flood plains and slightly higher stream benches along the major streams throughout the county. The soils are subject to flooding. The bottom land generally is characterized by old stream channels and oxbows that commonly are ponded. The flood plains, stream benches, and adjacent uplands are divided by steep, narrow escarpments in some areas.

This association makes up about 16 percent of the county. It is about 40 percent Spillville soils, 30 percent Coland soils, 15 percent Marshan soils, and 15 percent minor soils (fig. 4).

The somewhat poorly drained and moderately well drained Spillville and poorly drained Coland soils are on low, channeled flood plains adjacent to the major streams in the county. The poorly drained Marshan soils are in plane or slightly concave areas on stream benches. They are higher on the landscape than the Spillville and Coland soils. All of the major soils have a seasonal high water table.

Typically, the surface layer of the Spillville soils is black loam about 8 inches thick. The subsurface layer is black, very dark brown, and dark brown loam about 32 inches thick. The upper part of the substratum is brown, mottled sandy loam. The lower part to a depth of about 60 inches is yellowish brown, mottled loamy sand.

Typically, the surface layer of the Coland soils is black clay loam about 8 inches thick. The subsurface layer is

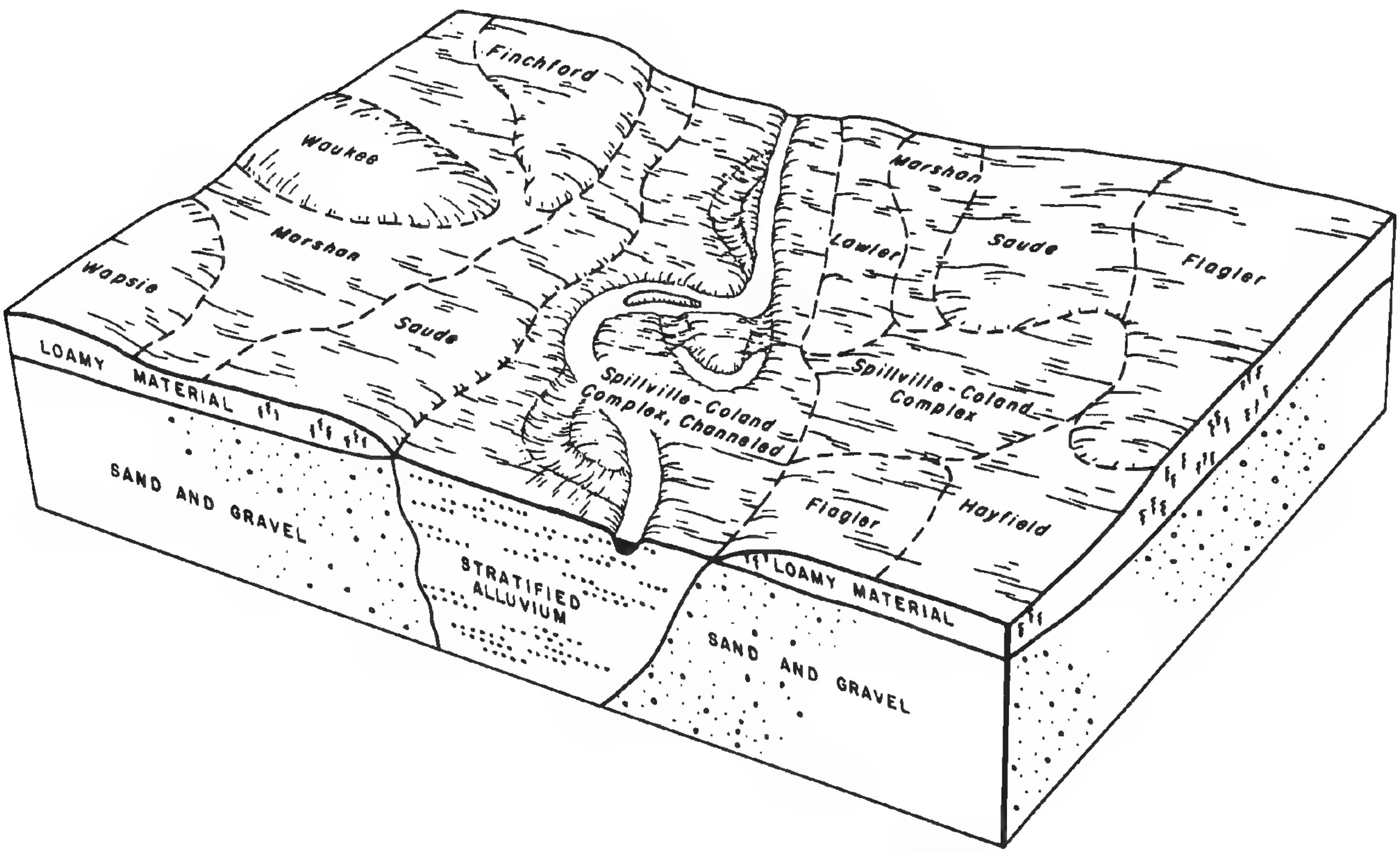

Figure 4.—Pattern of soils and parent material in the Spillville-Coland-Marshan association.

black and very dark gray clay loam about 40 inches thick. The substratum to a depth of about 60 inches is dark gray, mottled clay loam.

Typically, the surface layer of the Marshan soils is black clay loam about 6 inches thick. The subsurface layer is black clay loam about 15 inches thick. The subsoil is about 18 inches thick. The upper part is dark gray, mottled, friable clay loam; the next part is mottled dark grayish brown, grayish brown, and strong brown, friable loam; and the lower part is dark grayish brown, mottled, very friable gravelly sandy loam. The substratum to a depth of about 60 inches is yellowish brown, mottled gravelly loamy sand.

Minor in this association are the excessively drained Finchford soils, the somewhat excessively drained Flagler soils, the somewhat poorly drained Hayfield and Lawler soils, and the well drained Saude, Wapsie, and Waukee soils. Finchford and Flagler soils are on the high parts of stream benches. Hayfield and Lawler soils are in the lower lying areas on stream benches. Saude, Wapsie, and Waukee soils are at intermediate elevations on the benches.

The Spillville and Coland soils are used mainly as recreational areas, woodland, pasture, and wildlife habitat. The Marshan soils are used mainly for cultivated crops. Measures that maintain tilth and fertility are needed.

detailed soil map units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and management of the soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and identifies the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Kenyon loam, 2 to 5 percent slopes, is one of several phases in the Kenyon series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils that occur as areas so intricately mixed or so small that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Clyde-Floyd complex, 1 to 4 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. These dissimiliar soils are described in each map unit. Also, some of the more unusual or strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes some *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, sand and gravel, is an example. Some miscellaneous areas are large enough to be delineated on the soil maps. Some that are too small to be delineated are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

soil descriptions

41—Sparta loamy fine sand, 0 to 2 percent slopes. This nearly level, excessively drained soil is on stream benches and on uplands. Areas are irregularly shaped and commonly range from 2 to 30 acres in size.

Typically, the surface layer is very dark brown loamy fine sand about 9 inches thick. The subsurface layer is very dark brown and dark brown loamy fine sand about 16 inches thick. The subsoil is dark brown, very friable loamy fine sand about 17 inches thick. The substratum to a depth of about 60 inches is brown fine sand.

Included with this soil in mapping are small areas of the somewhat poorly drained Watseka soils. These soils have a higher available water capacity than the Sparta soil. They are in low lying areas and drainageways. They make up 5 to 10 percent of the unit.

Permeability is moderately rapid in the upper part of the Sparta soil and rapid in the lower part. Available water capacity is low. Surface runoff is slow. The shrink-swell potential is low. The surface layer typically is medium acid unless limed. The subsoil commonly is medium acid. It typically has a very low supply of available phosphorus and potassium. The content of organic matter is about 1 to 2 percent in the surface layer. This layer is very friable and can be easily tilled. It warms up early in the spring and can be worked soon after rains.

This soil is used primarily for row crops and for hay and pasture. It is poorly suited to corn, soybeans, and small grain. It is moderately suited to grasses and legumes for hay and pasture. Droughtiness is a limitation

in most years unless rainfall is timely. If cultivated crops are grown, wind erosion is a hazard. A conservation tillage system that leaves crop residue on the surface throughout the year and contour farming conserve moisture and help to control erosion. The hazard of wind erosion is increased by fall plowing. It can be reduced, however, by leaving the surface rough, by alternating plowed and unplowed strips, and by chisel plowing in areas where crop residue is left on the surface. Chisel plowing also conserves moisture. Returning crop residue to the soil or regularly adding other organic material improves fertility and tilth.

A cover of pasture plants or hay is effective in controlling erosion. Managing pasture is difficult, however, on this droughty soil. Permanent pasture can be improved by renovating and reseeding. Once the permanent pasture has been established, proper stocking rates, pasture rotation, timely deferment of grazing, especially during dry periods, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is moderately suited to trees. It supports trees in groves and around farmsteads, but few areas are extensively wooded. Seedling mortality is a severe limitation. As a result, seedlings should be planted at close intervals. Thinning the stand helps to provide adequate growing space for the surviving trees. Competing vegetation can be controlled by site preparation or by spraying or cutting.

The capability subclass is IVs.

41B—Sparta loamy fine sand, 2 to 5 percent slopes. This gently sloping, excessively drained soil generally is on convex slopes on uplands that are adjacent to a stream valley. It also is in isolated areas in the uplands and on alluvial benches and, in a few areas, on dunelike ridges oriented from northwest to southeast. Areas are irregularly shaped or round and range from 2 to more than 100 acres in size.

Typically, the surface layer is very dark grayish brown loamy fine sand about 7 inches thick. The subsurface layer is very dark grayish brown and dark brown loamy fine sand about 17 inches thick. The subsoil is very friable loamy fine sand about 16 inches thick. It is brown in the upper part and yellowish brown in the lower part. The substratum to a depth of about 60 inches is yellowish brown sand. In a few small areas, the soil contains more gravel and the content of organic matter is lower.

Included with this soil in mapping are some small areas of the somewhat excessively drained Burkhardt soils in similar positions on the landscape. These soils make up about 5 percent of the unit.

Permeability is moderately rapid in the upper part of the Sparta soil and rapid in the lower part. Available water capacity is low. Surface runoff is slow. The surface layer is very friable and can be easily tilled throughout a wide range of moisture content. It seldom crusts after hard rains or puddles if tilled when wet. The organic matter content is 1 to 1.5 percent in the surface layer. The shrink-swell potential is low throughout the soil. Reaction varies widely in the surface layer as a result of local liming practices. The subsoil is medium acid. It has a very low supply of available phosphorus and potassium.

Most areas are cultivated. Many small areas are cropped along with larger areas of adjacent soils that are well suited to crops.

This soil is poorly suited to corn and soybeans. It is better suited to small grain and to grasses and legumes for hay or pasture. Droughtiness is a severe limitation in most years unless rainfall is timely. If cultivated crops are grown, wind erosion is a hazard. The initial wind erosion occurs on round, convex shoulder slopes. Blowing sand grains sometimes damage newly seeded crops on this soil and on the adjoining soils unless the surface is protected by a plant cover. A conservation tillage system that leaves crop residue on the surface and cover crops help to prevent excessive soil loss. The soil warms up quickly in the spring, thus stimulating early plant growth. Returning crop residue to the soil or regularly adding other organic material improves fertility and increases the available water capacity.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet or too dry, however, reduces the extent of the protective plant cover and causes deterioration of the plant community. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture and the soil in good condition.

This soil is moderately suited to trees. It supports trees in groves and around farmsteads, but few areas are extensively wooded. Seedling mortality is a severe limitation. As a result, seedlings should be planted at close intervals. Thinning the stand helps to provide adequate growing space for the surviving trees. Competing vegetation can be controlled by site preparation or by spraying or cutting.

The capability subclass is IVs.

41C—Sparta loamy fine sand, 5 to 9 percent slopes. This moderately sloping, excessively drained soil generally is in areas adjacent to drainageways and in isolated areas on uplands. In a few areas it is on dunelike ridges oriented from northwest to southeast. Areas generally are irregularly shaped and range from 3 to 10 acres in size, but those on ridges are long and narrow and range from 10 to 20 acres in size.

Typically, the surface layer is very dark grayish brown loamy fine sand about 7 inches thick. The subsurface layer is dark brown loamy fine sand about 9 inches thick. The subsoil is yellowish brown, very friable loamy fine sand about 12 inches thick. The substratum to a depth

of about 60 inches is light yellowish brown, loose sand. In places it is loam glacial till.

Included with this soil in mapping are areas of gravelly loamy sand and gravelly sandy loam in similar positions on the landscape. These soils are lower in organic matter content than the Sparta soil and have a lower available water capacity. They make up less than 5 percent of the unit.

Permeability is moderately rapid in the upper part of the Sparta soil and rapid in the lower part. Available water capacity is low. Surface runoff is medium. The surface layer is very friable and can be easily tilled throughout a fairly wide range of moisture content. It seldom crusts after hard rains or puddles if tilled when wet. The organic matter content is 1 to 2 percent in the surface layer. The shrink-swell potential is low throughout the soil. Reaction varies widely in the surface layer as a result of local liming practices. The subsoil is medium acid. It has a very low supply of available phosphorus and potassium.

Most areas are pastured. A few small areas are cropped along with larger areas of adjacent soils that are well suited to crops.

This soil generally is poorly suited to cultivated crops, but it is suited to small grain and to grasses and legumes for hay or pasture. Droughtiness is a severe limitation in most years unless rainfall is timely. If cultivated crops are grown, wind erosion is a severe hazard.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet or too dry, however, reduces the extent of the protective plant cover and causes deterioration of the plant community. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture and the soil in good condition.

This soil is moderately suited to trees. It supports trees in groves and around farmsteads, but few areas are extensively wooded. Seedling mortality is a severe limitation. As a result, seedlings should be planted at close intervals. Thinning the stand helps to provide adequate growing space for the surviving trees. Competing vegetation can be controlled by site preparation or by spraying or cutting.

The capability subclass is IVs.

63B—Chelsea loamy fine sand, 2 to 5 percent slopes. This gently sloping, excessively drained soil generally is on convex slopes on uplands that are adjacent to a stream valley. It also is in isolated areas on alluvial benches and, in a few areas, on dunelike, low ridges oriented from northwest to southeast. Areas are irregularly shaped or round and range from 2 to more than 60 acres in size.

Typically, the surface layer is dark gray loamy fine sand about 5 inches thick. The subsurface layer is about 33 inches thick. The upper part is brown, very friable loamy fine sand, and the lower part is brown, loose fine sand. Below this to a depth of about 60 inches is brown fine sand that has bands of brown loamy fine sand 1/4 inch to 2 inches thick. In places the substratum is loam glacial till.

Included with this soil in mapping are small areas of the well drained Lamont soils in similar positions on the landscape. These soils have a higher available water capacity than the Chelsea soil. They make up less than 5 percent of the unit.

Permeability is rapid in the Chelsea soil. Available water capacity is low. Surface runoff is slow. The surface layer is very friable and can be easily tilled throughout a fairly wide range of moisture content. It seldom crusts after hard rains or puddles if tilled when wet. The organic matter content is about 0.5 to 1 percent in the surface layer. The shrink-swell potential is low throughout the soil. The lower part of the subsurface layer is strongly acid. Reaction varies widely in the surface layer and the upper part of the subsurface layer as a result of local liming practices. The subsurface layer has a very low supply of available phosphorus and potassium.

Most areas are pastured. A few small areas are cropped along with larger areas of adjacent soils that are well suited to crops.

This soil is poorly suited to corn and soybeans. It is better suited to small grain or to grasses or legumes for hay or pasture. Droughtiness is a severe limitation in most years unless rainfall is timely. If cultivated crops are grown, wind erosion is a hazard. The initial wind erosion occurs on round, convex shoulder slopes. Blowing sand grains sometimes damage newly seeded crops on this soil and on the adjoining soils unless the surface is protected by a plant cover. A conservation tillage system that leaves crop residue on the surface and cover crops help to prevent excessive soil loss. The soil warms up quickly in the spring, thus stimulating early plant growth. Returning crop residue to the soil or regularly adding other organic material improves fertility and increases the available water capacity.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet or too dry, however, reduces the extent of the protective plant cover and causes deterioration of the plant community. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture and the soil in good condition.

This soil is moderately suited to trees. It supports trees in groves and around farmsteads, but few areas are extensively wooded. Seedling mortality is a moderate limitation. As a result, seedlings should be planted at close intervals. Thinning the stand helps to provide adequate growing space for the surviving trees. Competing vegetation can be controlled by site preparation or by spraying or cutting.

The capability subclass is IVs.

63C—Chelsea loamy fine sand, 5 to 9 percent slopes. This moderately sloping, excessively drained soil is on moundlike ridges and convex side slopes on uplands that generally are adjacent to a stream valley. It also is in isolated areas in the glacial uplands and on alluvial benches. Areas are irregularly shaped or round and range from 3 to 20 acres in size.

Typically, the surface layer is very dark gray loamy fine sand about 5 inches thick. The subsurface layer is about 33 inches thick. The upper part is brown, very friable loamy fine sand, and the lower part is brown, loose fine sand. Below this to a depth of about 60 inches is brown, loose fine sand that has bands of brown loamy fine sand 1/4 inch to 2 inches thick.

Included with this soil in mapping are small areas of the well drained Lamont soils in similar positions on the landscape. These soils have a slightly higher available water capacity than the Chelsea soil. They make up less than 5 percent of the unit.

Permeability is rapid in the Chelsea soil. Available water capacity is low. Surface runoff is slow. The surface layer is very friable and can be easily tilled throughout a fairly wide range of moisture content. It seldom crusts after hard rains or puddles if tilled when wet. The organic matter content is about 0.5 percent in the surface layer. The shrink-swell potential is low throughout the soil. The lower part of the subsurface layer is strongly acid. Reaction varies widely in the surface layer and the upper part of the subsurface layer as a result of local liming practices. The subsurface layer has a very low supply of available phosphorus and potassium.

Most areas are pastured. A few small areas are cropped along with larger areas of adjacent soils that are well suited to crops.

This soil is poorly suited to corn and soybeans. It is better suited to small grain or to grasses or legumes for hay or pasture. Droughtiness is a severe limitation in most years unless rainfall is timely. If cultivated crops are grown, wind erosion is a hazard. The initial wind erosion occurs on round, convex shoulder slopes. Blowing sand grains sometimes damage newly seeded crops on this soil and on the adjoining soils unless the surface is protected by a plant cover. A conservation tillage system that leaves crop residue on the surface and cover crops help to prevent excessive soil loss. The soil warms up quickly in the spring, thus stimulating early plant growth, particularly on south- and east-facing slopes. Returning crop residue to the soil or regularly adding other organic material improves fertility and increases the available water capacity.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet or too dry, however, reduces the extent of the protective plant cover and causes deterioration of the plant community. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture and the soil in good condition.

This soil is moderately suited to trees. It supports trees in groves and around farmsteads, but few areas are extensively wooded. Seedling mortality is a moderate limitation. As a result, seedlings should be planted at close intervals. Thinning the stand helps to provide adequate growing space for the surviving trees. Competing vegetation can be controlled by site preparation or by spraying or cutting.

The capability subclass is IVs.

83B—Kenyon loam, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is on long, convex ridgetops and side slopes in the uplands. Areas are irregularly shaped and range from 2 to more than 100 acres in size.

Typically, the surface layer is very dark brown loam about 7 inches thick. The subsurface layer is very dark brown and very dark grayish brown loam about 13 inches thick. The subsoil is about 25 inches thick. The upper part is brown, friable loam, and the lower part is yellowish brown and dark yellowish brown, mottled, firm loam. The substratum to a depth of about 60 inches is mottled brown and grayish brown loam. In places the surface soil is thinner and has a lower content of organic matter.

Included with this soil in mapping are small areas of the somewhat poorly drained Floyd and Readlyn soils. Floyd soils are along upland drainageways, and Readlyn soils are at the head of drainageways. In some areas fieldwork is delayed unless the Floyd and Readlyn soils are drained. Included soils make up 5 to 10 percent of the unit.

Permeability is moderate in the Kenyon soil. Available water capacity is high. Surface runoff is medium. The surface layer is friable and can be easily tilled but tends to crust after hard rains and puddle if tilled when wet. The organic matter content is about 3 to 4 percent in the surface layer. The shrink-swell potential is low throughout the soil. Reaction typically is neutral to a depth of about 26 inches and strongly acid at a depth of about 33 inches. In some areas, however, it varies widely in the surface layer as a result of local liming practices. The subsoil has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to intensive cropping of corn and soybeans, to small grain, and to grasses or legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. A conservation tillage system that leaves crop residue on the surface, terraces, and grassed waterways help to prevent excessive soil loss. If terraces are built, cuts should not expose the less productive underlying glacial till. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent

surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability subclass is IIe.

83C—Kenyon loam, 5 to 9 percent slopes. This moderately sloping, moderately well drained soil is on short side slopes in the uplands. Areas are commonly somewhat narrow, irregularly shaped bands that range from 2 to 12 acres in size.

Typically, the surface layer is very dark brown loam about 8 inches thick. The subsurface layer is very dark grayish brown loam about 3 inches thick. The subsoil is about 37 inches thick. The upper part is brown, friable loam, and the lower part is dark yellowish brown and yellowish brown, firm loam. The substratum to a depth of about 60 inches is mottled brown and grayish brown loam. In places the surface soil is thinner and has a lower content of organic matter.

Permeability is moderate. Available water capacity is high. Surface runoff is medium. The surface layer is friable and can be easily tilled but tends to crust after hard rains and puddle if tilled when wet. The organic matter content is about 3 to 4 percent in the surface layer. The shrink-swell potential is low throughout the soil. Reaction typically is neutral or slightly acid in the surface soil and subsoil. In some areas, however, it varies in the surface layer as a result of local liming practices. The subsoil has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is moderately suited to corn and soybeans. It is well suited to small grain and to grasses or legumes for hay or pasture. If cultivated crops are grown, erosion is a moderate or severe hazard. Terraces, a conservation tillage system that leaves crop residue on the surface, and grassed waterways help to prevent excessive soil loss (fig. 5). If terraces are built, cuts should not expose the less productive underlying glacial till. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability subclass is IIIe.

83C2—Kenyon loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on short side slopes in the uplands. Areas commonly are somewhat narrow, irregularly shaped bands that range from 3 to 20 acres in size.

Typically, the surface layer is very dark grayish brown and brown loam about 7 inches thick. The subsoil is about 35 inches thick. The upper part is dark yellowish brown, friable loam, and the lower part is yellowish brown, firm loam. The substratum to a depth of about 60 inches is mottled yellowish brown and light brownish gray loam.

Permeability is moderate. Available water capacity is high. Surface runoff is medium. The surface layer is friable but tends to crust after hard rains and puddle if tilled when wet. Tilth generally is fair. The organic matter content is about 2 to 3 percent in the surface layer. The shrink-swell potential is low throughout the soil. Reaction typically is neutral to a depth of about 16 inches and strongly acid at a depth of about 26 inches. In some areas, however, it varies widely in the surface layer as a result of local liming practices. The subsoil has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is moderately suited to corn and soybeans. It is well suited to small grain and to grasses or legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. Terraces and a conservation tillage system that leaves crop residue on the surface help to prevent excessive soil loss. Grassed waterways help to prevent gully erosion. If terraces are built, cuts should not expose the less productive underlying glacial till. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration. More nitrogen generally is needed on this soil than on Kenyon soils that are less eroded. Also, more intensive management is needed to maintain productivity and tilth.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability subclass is IIIe.

84—Clyde clay loam, 0 to 3 percent slopes. This nearly level and very gently sloping, poorly drained soil is in drainageways and the lower concave areas on uplands. Areas are generally elongated and irregularly shaped and range from 10 to more than 100 acres in size.

Typically, the surface soil is black clay loam about 22 inches thick. The subsoil is about 38 inches thick. The

Figure 5.—Stripcropping and grassed waterways on Kenyon loam, 5 to 9 percent slopes. These measures help to control erosion.

upper part is dark gray, mottled, friable loam and grayish brown, mottled, very friable sandy loam; the next part is mottled yellowish brown and grayish brown, firm loam; and the lower part is dark yellowish brown, mottled, firm loam. The substratum to a depth of about 70 inches is dark yellowish brown, mottled loam. In places the surface soil is thicker and darker.

Included with this soil in mapping are small areas of the somewhat poorly drained Schley soils, the Marshan soils, and the very poorly drained Palms soils. Marshan soils contain more sand and less clay in the lower part of the subsoil than the Clyde soil. The included soils are on the lower parts of the landscape. They make up about 10 percent of the unit.

The Clyde soil is moderately permeable. It has a seasonal high water table. Available water capacity is high. Surface runoff is slow. The surface layer is friable but crusts after hard rains and puddles if tilled when wet. The organic matter content is about 7 to 9 percent in the surface layer. The shrink-swell potential is moderate. Reaction is neutral or slightly acid throughout the profile. The subsoil has a very low supply of available phosphorus and potassium.

Most areas are cultivated. If artificially drained and protected against runoff from the higher elevations, this soil is well suited to intensive cropping of corn and soybeans, to small grain, and to grasses or legumes for hay and pasture. If row crops are grown, a drainage system is needed to lower the water table and improve the timeliness of fieldwork (fig. 6). Glacial stones and boulders are common in many unimproved, undrained areas (fig. 7). They should be removed before the soil is tile drained and cultivated. Installing the tile is difficult in some areas because of the very friable, water-bearing sandy sediments. A conservation tillage system that leaves crop residue on the surface and grassed waterways help to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

Figure 6.—Installing a drainage system in an area of Clyde clay loam, 0 to 3 percent slopes.

Inadequately drained areas generally are pastured. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth, reduces the runoff rate, and damages the plant cover. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability subclass is IIw.

109B—Backbone fine sandy loam, 2 to 6 percent slopes. This gently sloping and moderately sloping, well drained soil is on convex ridges and side slopes in the uplands. Areas are irregularly shaped and range from 5 to 20 acres in size.

Typically, the surface layer is very dark grayish brown fine sandy loam about 8 inches thick. The subsoil is about 27 inches thick. The upper part is brown, very friable sandy loam, and the lower part is dark reddish gray, very firm clay loam. Fractured limestone bedrock is at a depth of about 35 inches.

Permeability is moderately rapid. Available water capacity is low. Surface runoff is medium. The surface layer is very friable and can be easily tilled throughout a fairly wide range of moisture content, but it tends to crust after hard rains or puddle if tilled when wet. The organic matter content in the surface layer is about 1 to 2 percent. The shrink-swell potential is low in the upper part of the subsoil and high in the lower part. The root zone extends only to the limestone bedrock. Reaction varies widely in the surface layer as a result of local liming practices. The subsoil is neutral. It has a very low supply of available phosphorus and potassium.

Some areas are cultivated. This soil is poorly suited to corn and soybeans. It is better suited to small grain and to grasses or legumes for hay and pasture. Droughtiness is a limitation in most years unless rainfall is timely. If cultivated crops are grown, wind erosion is a hazard. Blowing sand grains sometimes damage newly seeded crops on this soil and on the adjoining soils unless the surface is protected by a plant cover. A conservation

Figure 7.—Large boulders in an area of Clyde clay loam, 0 to 3 percent slopes.

tillage system that leaves crop residue on the surface, cover crops, and grassed waterways help to prevent excessive soil loss. The soil warms up quickly in the spring, thus stimulating early plant growth, particularly on south- and east-facing slopes. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet or too dry, however, reduces the extent of the protective plant cover and causes deterioration of the plant community. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture and the soil in good condition.

This soil is moderately suited to trees. Some areas remain in native hardwoods. Seedling mortality, plant competition, and the hazards or limitations that affect planting or harvesting are slight.

The capability subclass is IVs.

110—Lamont fine sandy loam, 0 to 2 percent slopes. This nearly level, well drained soil is on alluvial benches and uplands that generally are in or adjacent to stream valleys. Areas are irregularly shaped and range from 3 to about 12 acres in size.

Typically, the surface layer is dark grayish brown fine sandy loam about 8 inches thick. The subsurface layer is brown fine sandy loam about 8 inches thick. The subsoil is dark yellowish brown and yellowish brown, very friable sandy loam about 21 inches thick. The substratum to a depth of about 60 inches is yellowish brown, loose loamy sand. It has nearly horizontal layers of strong brown, very friable loamy sand 1/2 inch to 2 inches thick. In places it is loam glacial till.

Included with this soil in mapping are some small areas of the excessively drained Chelsea soils in similar positions on the landscape. These soils are slightly lower in organic matter content than the Lamont soil and have a lower available water capacity. They make up less than 5 percent of the unit.

Permeability is moderately rapid in the subsoil of the Lamont soil and rapid in the substratum. Available water capacity is moderate. Surface runoff is slow. The surface layer is friable and can be easily tilled throughout a fairly wide range of moisture content, but it tends to crust after hard rains or puddle if tilled when wet. The organic matter content is about 1 percent in the surface layer.

The shrink-swell potential is low throughout the soil. Reaction in the surface layer varies as a result of local liming practices. The subsoil is slightly acid to strongly acid. It has a medium supply of available phosphorus and a very low supply of available potassium.

Many areas are cultivated. Many small areas are cropped along with large areas of adjacent soils that are well suited to crops.

This soil is moderately suited to corn and soybeans, to small grain, and to grasses or legumes for hay and pasture. Droughtiness is a limitation in most years unless rainfall is timely. Areas on alluvial benches could be irrigated because they are nearly level and commonly are near an adequate water supply. A conservation tillage system that leaves crop residue on the surface and cover crops help to prevent excessive soil loss and conserve moisture during periods of low humidity and high velocity winds. The soil warms up quickly in the spring, thus stimulating early plant growth. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the available water capacity.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing and grazing when the soil is too wet or too dry, however, reduces the extent of the protective plant cover and causes deterioration of the plant community. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture and the soil in good condition.

This soil is moderately suited to trees. Some areas remain in native hardwoods. Seedling mortality, plant competition, and the hazards or limitations that affect planting or harvesting are slight.

The capability subclass is IIIs.

110B—Lamont fine sandy loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on convex slopes on alluvial benches and glaciated uplands that generally are adjacent to stream valleys. Areas are irregularly shaped and range from about 2 to 100 acres in size.

Typically, the surface layer is dark grayish brown fine sandy loam about 8 inches thick. The subsurface layer is brown fine sandy loam about 6 inches thick. The subsoil is about 22 inches of yellowish brown and dark yellowish brown, friable and very friable fine sandy loam and sandy loam. The substratum to a depth of about 60 inches is yellowish brown loamy sand. It has nearly horizontal layers of strong brown loamy sand 1/2 inch to 2 inches thick. In places it is loam glacial till.

Included with this soil in mapping are small areas of the excessively drained Chelsea soils in similar positions on the landscape. These soils are slightly lower in organic matter content than the Lamont soil, have a lower available water capacity, and are more susceptible to wind erosion. They make up about 5 percent of the unit.

Permeability is moderately rapid in the subsoil of the Lamont soil and rapid in the substratum. Available water capacity is moderate. Surface runoff is medium. The surface layer is friable and can be easily tilled throughout a fairly wide range of moisture content, but it tends to crust after hard rains or puddle if tilled when wet. The organic matter content in the surface layer is about 0.5 percent. The shrink-swell potential is low throughout the soil. Reaction in the surface layer varies as a result of local liming practices. The subsoil is slightly acid to strongly acid. It has a medium supply of available phosphorus and a very low supply of available potassium.

Some areas are cultivated. Many small areas are cropped along with large areas of adjacent soils that are well suited to crops.

This soil is moderately suited to corn and soybeans, to small grain, and to grasses or legumes for hay and pasture. If cultivated crops are grown, wind erosion is a hazard. The initial wind erosion occurs on round, convex shoulder slopes. Blowing sand grains sometimes damage newly seeded crops on this soil and on the adjoining soils unless the surface is protected by a plant cover. A conservation tillage system that leaves crop residue on the surface, cover crops, and grassed waterways help to prevent excessive soil loss. The soil is poorly suited to terracing because ridging the moderately coarse textured material is difficult and because the underlying coarse textured material is too close to the surface. If terraces are built, cuts should not expose the coarse textured material in terrace channels. Droughtiness is a limitation in most years unless rainfall is timely. The soil warms up quickly in the spring, thus stimulating early plant growth, particularly on south- and east-facing slopes. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the available water capacity.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing and grazing when the soil is too wet or too dry, however, reduces the extent of the protective plant cover and causes deterioration of the plant community. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture and the soil in good condition.

This soil is moderately suited to trees. Some areas remain in native hardwoods. Seedling mortality, plant competition, and the hazards or limitations that affect planting or harvesting are slight.

The capability subclass is IIIe.

141—Watseka loamy fine sand, 1 to 3 percent slopes. This very gently sloping, somewhat poorly drained soil is on convex slopes on alluvial benches and

on uplands. Areas are irregularly shaped and range from 2 to 10 acres in size.

Typically, the surface layer is very dark grayish brown loamy fine sand about 8 inches thick. The subsurface layer is very dark grayish brown loamy fine sand about 9 inches thick. The subsoil is about 17 inches thick. The upper part is mottled grayish brown, dark grayish brown, and brown, very friable loamy fine sand, and the lower part is brown, mottled, very friable loamy fine sand. The substratum to a depth of about 60 inches is light brownish gray sand.

This soil is rapidly permeable. It has a seasonal high water table. Available water capacity is low. Surface runoff is very slow. The surface layer is very friable and can be easily tilled throughout a fairly wide range of moisture content. It seldom crusts after hard rains or puddles if tilled when wet. The organic matter content in the surface layer is about 1 to 1.5 percent. The shrink-swell potential is low throughout the soil. Reaction varies widely in the surface layer as a result of local liming practices. The subsoil is medium acid or slightly acid. It has a very low supply of available phosphorus and potassium.

Many areas are cultivated. Many small areas are cropped along with larger areas of adjacent soils that are well suited to crops.

This soil is moderately suited to corn and soybeans. It is better suited to small grain and to grasses and legumes for hay and pasture. Droughtiness is a limitation during periods of below normal rainfall. The water table is moderately high in the spring but drops rapidly during the growing season. Installing tile is difficult in some areas because of the loose, water-bearing sand and gravel. If cultivated crops are grown, wind erosion is a hazard. The initial wind erosion occurs on round, convex shoulder slopes. Blowing sand grains sometimes damage newly seeded crops on this soil and on the adjoining soils unless the surface is protected by a plant cover. A conservation tillage system that leaves crop residue on the surface and cover crops help to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility and increases the rate of water infiltration.

A cover of pasture plants and hay is effective in controlling erosion. Overgrazing and grazing when the soil is too wet or too dry, however, reduces the extent of the protective plant cover and causes deterioration of the plant community. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture and the soil in good condition.

The capability subclass is IIIs.

151—Marshan clay loam, 24 to 32 inches to sand and gravel, 0 to 2 percent slopes. This nearly level, poorly drained soil is on alluvial benches. It is subject to flooding. Areas are irregularly shaped and range from 10 to more than 160 acres in size.

Typically, the surface layer is black clay loam about 8 inches thick. The subsurface layer is black clay loam about 12 inches thick. The subsoil is about 10 inches thick. The upper part is dark gray, friable clay loam, and the lower part is mottled grayish brown and strong brown, friable loam and very friable gravelly sandy loam. The substratum to a depth of about 60 inches is yellowish brown gravelly loamy sand. In places the subsoil extends to a depth of about 30 inches.

Included with this soil in mapping are small areas of the somewhat poorly drained Watseka and very poorly drained Palms soils. Watseka soils are in the higher lying areas. Palms soils are in depressions. Included soils make up 5 to 10 percent of the unit.

The Marshan soil is moderately permeable in the subsoil and rapidly permeable in the substratum. It has a seasonal high water table. Available water capacity is low. Surface runoff is slow. The surface layer is friable but crusts after hard rains and puddles if tilled when wet. The organic matter content is about 5 to 6 percent in the surface layer. The shrink-swell potential is moderate in the surface soil and subsoil and low in the substratum. Reaction is neutral or slightly acid throughout the profile. The subsoil has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to intensive cropping of corn and soybeans, to small grain, and to grasses or legumes for hay and pasture. If row crops are grown, a drainage system is needed to lower the water table and improve the timeliness of fieldwork. Measures that help to control the runoff from the higher elevations also are needed. Establishing adequate drainage outlets and installing drainage tile are difficult in some areas because of the loose, water-bearing sand and gravel. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

Inadequately drained areas generally are pastured. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability subclass is IIw.

152—Marshan clay loam, 32 to 40 inches to sand and gravel, 0 to 2 percent slopes. This nearly level, poorly drained soil is on alluvial benches. It is subject to flooding. Areas are irregularly shaped and range from 5 to more than 80 acres in size.

Typically, the surface layer is black clay loam about 6 inches thick. The subsurface layer is black clay loam about 15 inches thick. The subsoil is about 18 inches thick. The upper part is dark gray, friable clay loam; the

next part is mottled dark grayish brown, grayish brown, and strong brown, friable loam; and the lower part is dark grayish brown, very friable gravelly sandy loam. The substratum to a depth of about 60 inches is yellowish brown gravelly loamy sand. In places the subsoil extends to a depth of only about 28 inches.

Included with this soil in mapping are small areas of the somewhat poorly drained Watseka and very poorly drained Palms soils. Watseka soils are in the slightly higher lying areas. Palms soils are in depressions. Included soils make up about 5 to 10 percent of the unit.

The Marshan soil is moderately permeable in the subsoil and rapidly permeable in the substratum. It has a seasonal high water table. Available water capacity is moderate. Surface runoff is slow. The surface layer is friable but crusts after hard rains and puddles if tilled when wet. The organic matter content is about 5 to 6 percent in the surface layer. The shrink-swell potential is moderate in the surface soil and the subsoil and low in the substratum. Reaction is neutral or slightly acid throughout the profile. The subsoil has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to intensive cropping of corn and soybeans, to small grain, and to grasses or legumes for hay and pasture. If row crops are grown, a drainage system is needed to lower the water table and improve the timeliness of fieldwork. Measures that help to control the runoff from higher elevations also are needed. Establishing adequate drainage outlets and installing drainage tile are difficult in some areas because of the loose, water-bearing sand and gravel. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

Inadequately drained areas generally are pastured. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability subclass is IIw.

159—Finchford loamy sand, 0 to 2 percent slopes. This nearly level, excessively drained soil is on high alluvial benches. It is subject to flooding. Areas are irregularly shaped and somewhat elongated and range from 2 to 60 acres in size.

Typically, the surface layer is very dark grayish brown loamy sand about 8 inches thick. The subsurface layer is very dark grayish brown loamy sand about 14 inches thick. The subsoil is about 18 inches thick. The upper part is brown, loose loamy sand; the next part is dark yellowish brown, loose gravelly loamy sand; and the lower part is yellowish brown, loose sand. The substratum to a depth of about 60 inches is yellowish brown gravelly sand.

Permeability is very rapid. Available water capacity is low. Surface runoff is slow. The surface layer is very friable and can be easily tilled throughout a fairly wide range of moisture content. It seldom crusts after hard rains or puddles if tilled when wet. The organic matter content is about 1 to 1.5 percent in the surface layer. The shrink-swell potential is low throughout the soil. Reaction varies widely in the surface layer as a result of local liming practices. The subsoil is medium acid. It has a very low supply of available phosphorus and potassium.

A few areas are cultivated. Many small areas are cropped along with larger areas of adjacent soils that are well suited to crops.

This soil is poorly suited to corn and soybeans. It is better suited to small grain and to grasses and legumes for hay or pasture. Droughtiness is a severe limitation in most years unless rainfall is timely. Also, wind erosion is a hazard during most years. Areas on alluvial benches could be irrigated easily because they are nearly level and commonly are near an adequate water supply. A conservation tillage system that leaves crop residue on the surface and cover crops help to prevent excessive soil loss and conserve moisture during periods of low humidity and high velocity winds. The soil warms up quickly in the spring, thus stimulating early plant growth. Returning crop residue to the soil or regularly adding other organic material improves fertility and increases the available water capacity.

Many areas are used for pasture or hay. Overgrazing or grazing when the soil is too wet or too dry reduces the extent of the plant cover and causes deterioration of the plant community. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture and the soil in good condition.

The capability subclass is IVs.

159C—Finchford loamy sand, 2 to 9 percent slopes. This gently sloping and moderately sloping, excessively drained soil is on escarpments on alluvial benches. Slopes are short. Areas are irregularly shaped and elongated and range from 2 to 20 acres in size.

Typically, the surface layer is very dark grayish brown loamy sand about 8 inches thick. The subsurface layer is very dark grayish brown loamy sand about 7 inches thick. The subsoil is about 18 inches thick. The upper part is brown, loose loamy sand; the next part is dark yellowish brown, loose gravelly loamy sand; and the lower part is yellowish brown, loose sand. The substratum to a depth of about 60 inches is yellowish brown gravelly sand.

Permeability is very rapid. Available water capacity is low. Surface runoff is slow. The surface layer is very friable and can be easily tilled throughout a fairly wide range in moisture content. It seldom crusts after hard rains or puddles if tilled when wet. The organic matter

content is about 1 to 2 percent in the surface layer. The shrink-swell potential is low throughout the soil. Reaction varies widely in the surface layer as a result of local liming practices. The subsoil is medium acid. It has a very low supply of available phosphorus and potassium.

Most areas are pastured. A few small areas are cropped along with larger areas of adjacent soils that are well suited to crops.

This soil is poorly suited to corn and soybeans. It is better suited to small grain and to grasses or legumes for hay or pasture. Droughtiness is a severe limitation in most years unless rainfall is timely. If cultivated crops are grown, wind erosion is a hazard. Blowing sand grains sometimes damage newly seeded crops on this soil and on the adjoining soils unless the surface is protected by a plant cover. A conservation tillage system that leaves crop residue on the surface and cover crops help to prevent excessive soil loss. The soil warms up quickly in the spring, thus stimulating early plant growth. Returning crop residue to the soil or regularly adding other organic material improves fertility and increases the available water capacity.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet or too dry, however, reduces the extent of the protective plant cover and causes deterioration of the plant community. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture and the soil in good condition.

The capability subclass is IVs.

171B—Bassett loam, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is on uplands. Areas are irregularly shaped and range from 10 to 50 acres in size.

Typically, the surface layer is very dark grayish brown loam about 6 inches thick. The subsurface layer is very dark grayish brown loam about 3 inches thick. The subsoil is about 46 inches thick. The upper part is yellowish brown, friable loam; the next part is strong brown and mottled strong brown and light brownish gray, friable and firm loam; and the lower part is mottled strong brown and grayish brown, firm loam. The substratum to a depth of about 60 inches is mottled strong brown and grayish brown, calcareous loam. In places the surface layer is very dark grayish brown loamy sand or sandy loam.

Included with this soil in mapping are small areas of soils that have clayey material at a depth of 2 to 4 feet. These soils are on the lower parts of the landscape. They are more slowly permeable than the Bassett soil. The slower permeability increases the susceptibility to hillside seepage and thus increases the wetness. The wetness can interfere with the timeliness of fieldwork. Included soils make up less than 5 percent of the unit.

Permeability is moderate in the Bassett soil. Available water capacity is high. Surface runoff is medium. The surface layer is friable and can be easily tilled but tends to crust after hard rains and puddle if tilled when wet. The organic matter content is about 2 to 3 percent in the surface layer. The shrink-swell potential is low throughout the soil. Reaction varies widely in the surface layer as a result of local liming practices. It is strongly acid at a depth of about 20 inches. The subsoil has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to intensive cropping of corn and soybeans, to small grain, and to grasses or legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. A conservation tillage system that leaves crop residue on the surface, terraces, and grassed waterways help to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is suited to trees. Some small areas remain in native hardwoods. Competing vegetation can be controlled by proper site preparation, by prescribed burning, or by spraying, cutting, or girdling. Seedling mortality and the hazards or limitations that affect planting or harvesting are slight.

The capability subclass is IIe.

171C2—Bassett loam, 5 to 9 percent slopes, moderately eroded. This moderately sloping, moderately well drained soil is on convex side slopes in the uplands. Areas are irregularly shaped and range from 2 to 10 acres in size.

Typically, the surface layer is very dark grayish brown and brown loam about 6 inches thick. The subsoil is about 40 inches thick. The upper part is yellowish brown, friable loam; the next part is strong brown and mottled strong brown and light brownish gray, firm loam; and the lower part is mottled strong brown and grayish brown, firm loam. The substratum to a depth of about 60 inches is mottled strong brown and grayish brown, calcareous loam.

Permeability is moderate. Available water capacity is high. Surface runoff is medium. The surface layer is friable and can be easily tilled but tends to crust after hard rains and puddle if tilled when wet. The organic matter content in the surface layer is about 1.5 to 2 percent. The shrink-swell potential is low throughout the soil. Reaction varies widely in the surface layer as a result of local liming practices. It is strongly acid at a

depth of about 20 inches. The subsoil has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is moderately suited to corn and soybeans, to small grain, and to grasses or legumes for hay or pasture. If cultivated crops are grown, further erosion is a hazard. A conservation tillage system that leaves crop residue on the surface, contour farming, and terraces help to prevent excessive soil loss. Grassed waterways help to prevent gully erosion. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration. More nitrogen generally is needed on this soil than on Bassett soils that are less eroded. Also, more intensive management is needed to maintain productivity and tilth.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is suited to trees. Some small areas remain in native hardwoods. Competing vegetation can be controlled by proper site preparation, by prescribed burning, or by spraying, cutting, or girdling. Seedling mortality and the hazards or limitations that affect planting or harvesting are slight.

The capability subclass is IIIe.

175—Dickinson fine sandy loam, 0 to 2 percent slopes. This nearly level, somewhat excessively drained soil is on alluvial benches and glaciated uplands. Areas are irregularly shaped and range from 2 to 20 acres in size.

Typically, the surface layer is black fine sandy loam about 8 inches thick. The subsurface layer is dark grayish brown fine sandy loam about 12 inches thick. The subsoil is about 26 inches thick. It is brown and dark yellowish brown, very friable fine sandy loam in the upper part and yellowish brown, very friable loamy fine sand in the lower part. The substratum to a depth of about 60 inches is yellowish brown fine sand. In places the surface layer is dark brown gravelly loamy sand.

Included with this soil in mapping are small areas of the excessively drained Sparta soils in similar positions on the landscape. These soils make up less than 5 percent of the unit.

Permeability is moderately rapid in the upper part of the Dickinson soil and rapid in the lower part. Available water capacity is low. Surface runoff is slow. The surface layer is very friable and can be easily tilled throughout a fairly wide range of moisture content, but it tends to crust after hard rains or puddle if tilled when wet. The organic matter content is about 1.5 to 2 percent in the surface layer. The shrink-swell potential is low throughout the soil. Reaction varies widely in the surface layer as a result of local liming practices. The subsoil is neutral or slightly acid. It has a very low supply of available phosphorus and potassium.

Most areas are cultivated. Many small areas are cropped along with larger areas of adjacent soils that are better suited to crops.

This soil is moderately suited to corn and soybeans, to small grain, and to grasses or legumes for hay and pasture. Droughtiness is a limitation in most years unless rainfall is timely. Also, wind erosion is a hazard during most years. Areas on alluvial benches could be irrigated easily because they are nearly level and commonly are near an adequate water supply. A conservation tillage system that leaves crop residue on the surface and cover crops help to prevent excessive soil loss and conserve moisture during periods of low humidity and high velocity winds. The soil warms up quickly in the spring, thus stimulating early plant growth. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the available water capacity.

Some areas are used for pasture or hay. Overgrazing and grazing when the soil is too wet or too dry reduces the extent of the protective plant cover and causes deterioration of the plant community. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture and the soil in good condition.

The capability subclass is IIIs.

175B—Dickinson fine sandy loam, 2 to 5 percent slopes. This gently sloping, somewhat excessively drained soil is on glaciated uplands and alluvial benches. Areas are irregularly shaped or oval and range from 2 to 60 acres in size.

Typically, the surface layer is black fine sandy loam about 8 inches thick. The subsurface layer is very dark grayish brown fine sandy loam about 11 inches thick. The subsoil is about 26 inches thick. It is brown and dark yellowish brown, very friable fine sandy loam in the upper part and yellowish brown, very friable loamy fine sand in the lower part. The substratum to a depth of about 60 inches is yellowish brown fine sand. In places the surface layer is dark brown gravelly loamy sand.

Included with this soil in mapping are small areas of the excessively drained Sparta soils in similar positions on the landscape. These soils make up about 5 percent of the unit.

Permeability is moderately rapid in the upper part of the Dickinson soil and rapid in the lower part. Available water capacity is low. Surface runoff is medium. The surface layer is very friable and can be easily tilled throughout a fairly wide range of moisture content, but it tends to crust after hard rains or puddle if tilled when wet. The organic matter content of the surface layer is about 1 to 1.5 percent. The shrink-swell potential is low

throughout the soil. Reaction varies widely in the surface layer as a result of local liming practices. The subsoil is neutral or slightly acid. It has a very low supply of available phosphorus and potassium.

Most areas are cultivated. Many small areas are cropped along with larger areas of adjacent soils that are better suited to crops.

This soil is moderately suited to corn and soybeans, to small grain, and to grasses or legumes for hay and pasture. Droughtiness is a limitation in most years unless rainfall is timely. Also, wind erosion is a hazard in areas where cultivated crops are grown. Blowing sand grains sometimes damage newly seeded crops on this soil and on the adjoining soils unless the surface is protected by a plant cover. A conservation tillage system that leaves crop residue on the surface, cover crops, and grassed waterways help to prevent excessive soil loss. The soil is poorly suited to terracing because ridging the moderately coarse textured material is difficult and because the underlying coarse textured material is too close to the surface. If terraces are built, cuts should not expose the coarse textured material in terrace channels. The soil warms up quickly in the spring, thus stimulating early plant growth. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the available water capacity.

Some areas are used for pasture or hay. Overgrazing reduces the extent of the protective plant cover and causes deterioration of the plant community. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during excessively wet or dry periods help to keep the pasture and the soil in good condition.

The capability subclass is IIIs.

177—Saude loam, 0 to 2 percent slopes. This nearly level, well drained soil is on alluvial benches. Areas are irregularly shaped and range from 2 to 80 acres in size.

Typically, the surface layer is very dark brown loam about 7 inches thick. The subsurface layer is very dark brown loam about 9 inches thick. The subsoil is about 18 inches thick. The upper part is brown, friable loam, and the lower part is dark yellowish brown, very friable gravelly loamy sand. The substratum to a depth of about 60 inches is yellowish brown gravelly sand (fig. 8).

Permeability is moderate in the subsoil and very rapid in the substratum. Available water capacity is low. Surface runoff is slow. The surface layer is friable and can be easily tilled, but it tends to crust after hard rains and puddle if tilled when wet. The organic matter content in the surface layer is about 3 to 4 percent. The shrink-swell potential is low in the upper part of the soil and very low in the substratum. The underlying sand and gravel somewhat limit the depth to which the roots of some crops can penetrate. Reaction varies widely in the surface layer as a result of local liming practices. The subsoil is slightly acid or medium acid. It has a low

Figure 8.—Profile of Saude loam, 0 to 2 percent slopes. This soil is underlain by sand and gravel at a depth of 20 to 30 inches.

supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is moderately suited to corn and soybeans, to small grain, and to grasses or legumes for hay or pasture. Droughtiness is a limitation in most years unless rainfall is timely. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

Some areas are used for pasture or hay. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability subclass is IIs.

177B—Saude loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on alluvial benches. Areas are irregularly shaped and somewhat elongated and range from 2 to 10 acres in size.

Typically, the surface layer is very dark brown loam about 7 inches thick. The subsoil is about 16 inches thick. The upper part is brown, friable loam, and the lower part is dark yellowish brown, very friable gravelly loamy sand. The substratum to a depth of about 60 inches is yellowish brown, loose gravelly sand.

Included with this soil in mapping are small areas of soils that have a gravelly loamy sand surface layer. These soils are lower in organic matter content than the Saude soil and have a lower available water capacity. They are in similar positions on the landscape. They make up less than 5 percent of the unit.

Permeability is moderate in the subsoil of the Saude soil and very rapid in the substratum. Available water capacity is low. Surface runoff is medium. The surface layer is friable and can be easily tilled, but it tends to crust after hard rains and puddle if tilled when wet. The organic matter content is about 2 to 3 percent in the surface layer. The shrink-swell potential is low in the upper part of the soil and very low in the substratum. The underlying sand and gravel somewhat limit the depth to which the roots of some crops can penetrate. Reaction varies widely in the surface layer as a result of local liming practices. The subsoil is slightly acid or medium acid. It has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is moderately suited to corn and soybeans, to small grain, and to grasses and legumes for hay or pasture. If cultivated crops are grown, erosion is a hazard. A conservation tillage system that leaves crop residue on the surface and grassed waterways help to prevent excessive soil loss. The soil is poorly suited to terracing because the coarse textured material is too close to the surface. If terraces are built, cuts should not expose the coarse textured material in terrace channels. Droughtiness is a limitation in most years unless rainfall is timely. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

Some areas are used for pasture or hay. Overgrazing or grazing when the soil is too wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability subclass is IIe.

178—Waukee loam, 0 to 2 percent slopes. This nearly level, well drained soil is on alluvial benches. Areas are irregularly shaped and range from 10 to 50 acres in size.

Typically, the surface layer is black loam about 8 inches thick. The subsurface layer is black and very dark brown loam about 10 inches thick. The subsoil is about 27 inches thick. The upper part is brown, friable loam, and the lower part is brown, very friable sandy loam and yellowish brown, very friable gravelly loamy sand. The substratum to a depth of about 60 inches is yellowish brown gravelly sand.

Included with this soil in mapping are small areas of soils that have a loamy sand, sand, or gravelly loamy sand surface layer. These soils are lower in organic matter content than the Waukee soil and have a lower available water capacity. They are in similar positions on the landscape. Also included are small areas of poorly drained soils in slight depressions. Tillage is delayed in some areas unless these included soils are drained. Included soils make up about 5 percent of the unit.

Permeability is moderate in the subsoil of the Waukee soil and very rapid in the substratum. Available water capacity is moderate. Surface runoff is slow. The surface layer is friable and can be easily tilled, but it tends to crust after hard rains and puddle if tilled when wet. The organic matter content is about 3 to 4 percent in the surface layer. The shrink-swell potential is low throughout the soil. Reaction varies widely in the surface layer as a result of local liming practices. The subsoil is medium acid. It has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is well suited to intensive cropping of corn and soybeans, to small grain, and to grasses or legumes for hay and pasture. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

Some areas are used for pasture or hay. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability subclass is IIs.

184—Klinger silty clay loam, 1 to 3 percent slopes. This very gently sloping, somewhat poorly drained soil is on slightly convex ridgetops and side slopes in the uplands. Areas are irregularly shaped and range from 10 to more than 100 acres in size.

Typically, the surface layer is black silty clay loam about 7 inches thick. The subsurface layer is black silty clay loam about 6 inches thick. The subsoil is about 30 inches thick. The upper part is dark grayish brown and olive brown, friable silty clay loam; the next part is mottled grayish brown and strong brown, friable sandy loam; and the lower part is mottled grayish brown and yellowish brown, firm loam. The upper part of the substratum is mottled grayish brown, yellowish brown, and strong brown loam. The lower part to a depth of about 60 inches is yellowish brown, mottled loam.

This soil is moderately permeable. It has a seasonal high water table. Available water capacity is high. Surface runoff is slow. The surface layer is friable and can be easily tilled but crusts after hard rains and puddles if tilled when wet. The organic matter content is about 5 to 6 percent in the surface layer. The shrink-swell potential is moderate in the surface soil and low in the underlying firm glacial till. Reaction varies widely in the surface layer as a result of local liming practices. The subsoil is slightly acid or medium acid. It has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to intensive cropping of corn and soybeans, to small grain, and to grasses or legumes for hay and pasture. If cultivated crops are grown, erosion can be a hazard. A conservation tillage system that leaves crop residue on the surface helps to prevent excessive soil loss. In some areas tile drainage is needed to reduce the wetness and improve the timeliness of fieldwork. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

Some areas are used for pasture or hay. Overgrazing or grazing when the soil is too wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability class is I.

198B—Floyd loam, 1 to 4 percent slopes. This gently sloping, somewhat poorly drained soil is on concave slopes and on side slopes along upland drainageways. Areas are irregularly shaped and range from 2 to 80 acres in size.

Typically, the surface layer is black loam about 12 inches thick. The subsurface layer is very dark grayish brown loam about 6 inches thick. The subsoil is about 40 inches thick. The upper part is dark grayish brown, friable loam and mottled brown, grayish brown, and yellowish brown, very friable sandy loam, and the lower part is mottled yellowish brown, brown, and grayish brown, firm loam. The substratum to a depth of about 60 inches is brown, mottled loam. In places the surface soil is thinner and lighter colored.

This soil is moderately permeable. It has a seasonal high water table. Available water capacity is high. Surface runoff is slow. The surface layer is friable and can be easily tilled, but it tends to crust after hard rains and puddle if tilled when wet. The organic matter content is about 5 to 7 percent in the surface layer. The shrink-swell potential is moderate in the surface soil and low in the subsoil and substratum. The soil is neutral or slightly acid throughout. The subsoil has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to intensive cropping of corn and soybeans, to small grain, and to grasses or legumes for hay and pasture. If row crops are grown, a drainage system is needed to lower the water table and improve the timeliness of fieldwork. Gully erosion is a hazard in areas of concentrated runoff. Measures that help to control runoff from the higher elevations are needed. A combination of terraces and drainage tile is needed in some areas both to control erosion and to reduce the wetness. Glacial stones and boulders are common in many unimproved, undrained areas. They should be removed before the soil is tile drained and cultivated. Installing tile is difficult in some areas because of the very friable, water-bearing erosional sediments. A conservation tillage system that leaves crop residue on the surface helps to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

Inadequately drained areas generally are pastured. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth, reduces the runoff rate, and damages the plant cover. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability subclass is IIw.

205B—Whalan silt loam, 30 to 40 inches to limestone, 2 to 5 percent slopes. This gently sloping, well drained soil is on uplands. Areas are irregularly shaped or round and range from 3 to 10 acres in size.

Typically, the surface layer is very dark gray silt loam about 3 inches thick. The subsurface layer is brown silt loam about 6 inches thick. The subsoil is about 27 inches thick. The upper part is yellowish brown, friable silt loam and loam; the next part is yellowish brown and strong brown, firm clay loam and the lower part is yellowish brown, firm silty clay. Fractured limestone bedrock is at a depth of about 36 inches.

Included with this soil in mapping are small areas where limestone bedrock is exposed. These areas are lower in organic matter content than the Whalan soil and have a lower available water capacity. They are in similar positions on the landscape. The exposed limestone interferes with tillage. Included areas make up less than 5 percent of the unit.

Permeability is moderate in the Whalan soil. Available water capacity is low. Surface runoff is medium. The surface layer is friable and can be easily tilled but crusts after hard rains and puddles if tilled when wet. The organic matter content is about 1 percent in the surface layer. The shrink-swell potential is low in the upper part of the soil and high in the lower part. The root zone is limited by the limestone bedrock. Reaction ranges from strongly acid in the upper part of the subsoil to neutral in the lower part. It varies widely in the surface layer as a result of local liming practices. The subsoil has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to corn and soybeans, to small grain, and to grasses or legumes for hay or pasture. Droughtiness is a limitation during periods of below normal rainfall. If cultivated crops are grown, erosion is a hazard. A conservation tillage system that leaves crop residue on the surface, terraces, and contour farming help to prevent excessive soil loss and conserve moisture during periods of low rainfall. If terraces are constructed, cuts should not expose the underlying bedrock. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to trees. A few areas remain in native hardwoods. Competing vegetation can be controlled by proper site preparation, by prescribed burning, or by spraying, cutting, or girdling. Seedling mortality and the hazards or limitations that affect planting or harvesting are slight.

The capability subclass is IIs.

207B—Whalan silt loam, 20 to 30 inches to limestone, 2 to 5 percent slopes. This gently sloping, well drained soil is on uplands. Areas are irregularly shaped and range from 4 to 25 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 7 inches thick. The subsurface layer is brown silt loam about 6 inches thick. The subsoil is about 19 inches thick. The upper part is yellowish brown, friable silt loam and loam; the next part is yellowish brown, firm clay loam; and the lower part is strong brown, firm silty clay. Fractured limestone bedrock is at a depth of about 26 inches.

Permeability is moderate. Available water capacity is low. Surface runoff is medium. The surface layer is friable and can be easily tilled, but it crusts after hard rains and puddles if tilled when wet. The organic matter content is about 1 percent in the surface layer. The shrink-swell potential is low in the upper part of the soil and high in the lower part. The root zone is limited by the limestone bedrock. Reaction ranges from strongly acid in the upper part of the subsoil to neutral in the lower part. It varies widely in the surface layer as a result of local liming practices. The subsoil has a very low supply of available phosphorus and potassium.

Some areas are cultivated. This soil is moderately suited to corn and soybeans, to small grain, and to grasses or legumes for hay or pasture. If cultivated crops are grown, erosion is a hazard. A conservation tillage system that leaves crop residue on the surface and contour farming help to prevent excessive soil loss. The soil is poorly suited to terracing because the limestone bedrock is too close to the surface. If terraces are built, cuts should not expose the bedrock in terrace channels. Droughtiness is a limitation in most years unless rainfall is timely. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is moderately suited to trees. Some areas remain in native hardwoods. Competing vegetation can be controlled by proper site preparation, by prescribed burning, or by spraying, cutting, or girdling. Seedling mortality and the hazards or limitations that affect planting or harvesting are slight.

The capability subclass is IIe.

213B—Rockton loam, 30 to 40 inches to limestone, 2 to 6 percent slopes. This gently sloping and moderately sloping, well drained soil is on convex ridges and side slopes on uplands and escarpments. Areas are irregularly shaped and range from 2 to 20 acres in size.

Typically, the surface layer is very dark gray loam about 7 inches thick. The subsurface layer is very dark gray and very dark grayish brown loam about 11 inches thick. The subsoil is friable loam about 16 inches thick. The upper part is brown, and the lower part is dark yellowish brown. Fractured limestone bedrock is at a depth of about 34 inches. In some areas rinds of grayish brown residuum are on limestone fragments in the upper part of the bedrock.

Included with this soil in mapping are small areas of Atkinson soils on convex ridges. These soils are deep over limestone bedrock. They make up less than 5 percent of the unit.

Permeability is moderate in the Rockton soil. Available water capacity also is moderate. Surface runoff is medium. The surface layer is friable and can be easily tilled but tends to crust after hard rains and puddle if tilled when wet. The organic matter content is about 3 to 4 percent in the surface layer. The shrink-swell potential is moderate in the subsoil. The root zone is limited by the limestone bedrock. Reaction varies widely in the surface layer as a result of local liming practices. The subsoil is slightly acid. It has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to corn and soybeans, to small grain, and to grasses or legumes for hay or pasture. If cultivated crops are grown, erosion is a hazard. A conservation tillage system that leaves crop residue on the surface, terraces, and contour farming help to prevent excessive soil loss and conserve moisture during periods of low rainfall. If terraces are constructed, cuts should not expose the underlying bedrock. Droughtiness is a limitation during periods of below normal rainfall. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability subclass is IIe.

214—Rockton loam, 20 to 30 inches to limestone, 0 to 2 percent slopes. This nearly level, well drained soil is on uplands. Areas are irregularly shaped and range from 10 to 100 acres in size.

Typically, the surface layer is very dark brown loam about 7 inches thick. The subsurface layer is very dark grayish brown loam about 9 inches thick. The subsoil is about 8 inches of brown, friable loam and dark yellowish brown, friable clay loam. Fractured limestone bedrock is at a depth of about 24 inches. In some areas rinds of grayish brown residuum are on limestone fragments in the upper part of the bedrock. In some small areas the soil is somewhat excessively drained.

Permeability is moderate. Available water capacity is low. Surface runoff is slow. The surface layer is friable and can be easily tilled but tends to crust after hard rains and puddle if tilled when wet. The organic matter content is about 3 to 4 percent in the surface layer. The shrink-swell potential is moderate in the subsoil. The root zone is limited by the limestone bedrock. Reaction varies widely in the surface layer as a result of local liming practices. The subsoil is slightly acid. It has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is moderately suited to corn and soybeans, to small grain, and to grasses or legumes for hay and pasture. Droughtiness is a limitation in most years unless rainfall is timely. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

Some areas are used for pasture or hay. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability subclass is IIs.

221—Palms muck, 1 to 4 percent slopes. This gently sloping, very poorly drained soil generally is on the lower hillsides in the uplands and in broad upland drainageways. In some areas it is on alluvial benches. It is subject to flooding and ponding. Areas are round or elongated and range from 3 to 100 acres in size.

Typically, the surface layer is black muck about 10 inches thick. The subsurface layer is black muck about 35 inches thick. The substratum to a depth of about 60 inches is black, friable mucky silt loam.

Permeability is moderately slow to moderately rapid in the muck and moderately slow or moderate in the substratum. The soil has a seasonal high water table. Surface runoff is very slow. Available water capacity is very high. The surface layer is hummocky unless the soil is drained and leveled. Tilth is poor. The organic matter content is more than 75 percent in the surface layer. The shrink-swell potential is low in the substratum. Reaction is neutral to a depth of more than 60 inches. The supply of available phosphorus and potassium is very low.

Most areas are undrained and left idle. This soil is moderately suited to corn and soybeans if artificially drained. It is suited to small grain, but oats generally lodge and yields are reduced. The soil generally is wet because it is in or near seepy areas or buried springs where water that is frequently under pressure seeps to the surface. Installing an adequate drainage system is difficult. A system that is designed to intercept the seepage water is the most successful. If the soil is artificially drained, the organic material settles around the installed tile. Shrinkage of the organic material can alter tile alignment and cause the drainage system to function improperly. As a result, tile drains should be installed in the mineral substratum. In some areas obtaining suitable outlets is difficult.

This soil is poorly suited to pasture unless it is drained and renovated. The spongy material will not withstand the traffic of grazing livestock. Proper stocking rates,

pasture rotation, and timely deferment of grazing help to keep the pasture in good condition and help to control the growth of undesirable species, such as sedges and willows.

This soil is poorly suited to trees because it has a seasonal high water table and remains wet for long periods after rainfall. Special equipment commonly is needed. Operating this equipment is difficult, however, because of the spongy surface layer. A drainage system is needed to reduce seedling mortality.

The capability subclass is IIIw.

225—Lawler loam, 24 to 32 inches to sand and gravel, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on alluvial benches. Areas are irregularly shaped and range from 2 to more than 100 acres in size.

Typically, the surface layer is very dark brown loam about 8 inches thick. The subsurface layer is very dark grayish brown loam about 8 inches thick. The subsoil is about 14 inches thick. The upper part is dark grayish brown, friable loam, and the lower part is mottled grayish brown and brown, very friable gravelly loamy sand. The substratum to a depth of about 60 inches is brown sand and gravel.

Included with this soil in mapping are small areas of soils that have a loamy sand or gravelly loamy sand surface layer. These soils are low in organic matter content and have a low available water capacity. They are in positions on the landscape similar to those of the Lawler soil. Also included are small areas of poorly drained soils in slight depressions. Tillage commonly is delayed unless these included soils are drained. Included soils make up about 5 to 7 percent of the unit.

The Lawler soil is moderately permeable in the subsoil and very rapidly permeable in the substratum. It has a seasonal high water table. Available water capacity is low or moderate. Surface runoff is slow. The surface layer is friable and can be easily tilled, but it tends to crust after hard rains and puddle if tilled when wet. The organic matter content is about 4 to 5 percent in the surface layer. The shrink-swell potential is low throughout the soil. The underlying sand and gravel somewhat limit the depth to which the roots of some crops can penetrate. Reaction varies widely in the surface layer as a result of local liming practices. The subsoil is medium acid or strongly acid. It has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to corn and soybeans, to small grain, and to grasses or legumes for hay or pasture. Droughtiness is a limitation during periods of below normal rainfall. The water table is moderately high in the spring but drops rapidly during the growing season. In some areas tile drainage is beneficial during wet periods, but installing the tile is difficult because of the loose, water-bearing sand and gravel. If cultivated crops are grown, erosion is a hazard in areas that are fall plowed and are not protected. A conservation tillage system that leaves crop residue on the surface helps to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay improves soil aeration and tilth. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability subclass is IIs.

226—Lawler loam, 32 to 40 inches to sand and gravel, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on alluvial benches. Areas are irregularly shaped and range from 2 to 20 acres in size.

Typically, the surface layer is very dark brown loam about 8 inches thick. The subsurface layer is very dark brown and very dark grayish brown loam about 8 inches thick. The subsoil is about 22 inches thick. It is mottled. The upper part is dark grayish brown, friable loam; the next part is brown, very friable sandy loam; and the lower part is brown, very friable gravelly loamy sand. The substratum to a depth of about 60 inches is grayish brown and brown, mottled gravelly loamy sand and sand and fine gravel.

Included with this soil in mapping are small areas of poorly drained soils in slight depressions. Tillage is delayed in some areas unless these included soils are drained. Included soils make up less than 5 percent of the unit.

The Lawler soil is moderately permeable in the subsoil and very rapidly permeable in the substratum. It has a seasonal high water table. Available water capacity is moderate. Surface runoff is slow. The surface layer is friable and can be easily tilled, but it tends to crust after hard rains and puddle if tilled when wet. The organic matter content in the surface layer is about 4 to 5 percent. The shrink-swell potential is low throughout the soil. Reaction varies widely in the surface layer as a result of local liming practices. The subsoil is dominantly medium acid or strongly acid. It has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to intensive cropping of corn and soybeans, to small grain, and to grasses or legumes for hay and pasture. Droughtiness is a limitation in most years unless rainfall is timely. Fieldwork is more timely in areas that have been fall plowed. Erosion is a hazard, however, unless these areas are protected. A conservation tillage system that leaves crop residue on the surface helps to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility,

helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay improves soil aeration and tilth. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability subclass is IIs.

241B—Burkhardt-Saude complex, 2 to 5 percent slopes. These gently sloping, somewhat excessively drained and well drained soils are on convex ridges and side slopes in the uplands. Areas are irregularly shaped and range from 2 to 80 acres in size. They are about 60 percent Burkhardt soil and 40 percent Saude soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Burkhardt soil has a surface layer of very dark grayish brown sandy loam about 7 inches thick. The subsurface layer is dark brown sandy loam about 6 inches thick. The subsoil is brown, very friable sandy loam about 5 inches thick. The upper 17 inches of the substratum is brown and strong brown gravelly coarse sand. The lower part to a depth of about 60 inches is strong brown sand and coarse sand in which the content of fine gravel is about 15 percent.

Typically, the Saude soil has a surface layer of very dark gray loam about 7 inches thick. The subsurface layer is dark brown loam about 7 inches thick. The subsoil is about 41 inches thick. The upper part is dark yellowish brown and brown, friable loam; the next part is brown, friable loam; and the lower part is brown, very friable gravelly loamy coarse sand that has dark reddish brown mottles. The substratum to a depth of about 60 inches is strong brown and reddish brown loam. In places the surface layer has a lower content of organic matter.

Permeability is moderately rapid in the subsoil of the Burkhardt soil and rapid in the substratum. It is moderate in the subsoil of the Saude soil and very rapid in the substratum. Available water capacity is low or very low in both soils. Surface runoff is medium. The surface layer is friable or very friable and can be easily tilled, but it tends to crust after hard rains and puddle if tilled when wet. The organic matter content is about 2 to 4 percent in the surface layer. The shrink-swell potential is low or very low. Reaction varies widely in the surface layer as a result of local liming practices. The subsoil is medium acid or strongly acid. It has a very low supply of available phosphorus and potassium.

Most areas are cultivated. These soils are poorly suited to corn and soybeans. They are better suited to small grain or to grasses or legumes for hay or pasture. Droughtiness is a limitation in most years unless rainfall is timely. If cultivated crops are grown, erosion is a hazard. A conservation tillage system that leaves crop residue on the surface helps to prevent excessive soil loss and conserve moisture. The soils are poorly suited to terracing because the coarse textured material in the lower part of the subsoil is too close to the surface. If terraces are built, cuts should not expose this coarse material in terrace channels. Returning crop residue to the soils or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration and the available water capacity.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and a deterioration of tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soils in good condition.

The Burkhardt soil is moderately suited to trees. It supports trees in groves and around farmsteads, but few areas are extensively wooded. Seedling mortality is a moderate limitation. As a result, seedlings should be planted at close intervals. Thinning the stand helps to provide adequate growing space for the surviving trees. Competing vegetation can be controlled by site preparation or by spraying or cutting.

The capability subclass is IVs.

284—Flagler sandy loam, 0 to 2 percent slopes. This nearly level, somewhat excessively drained soil is on alluvial benches. Areas are irregularly shaped and range from 2 to 80 acres in size.

Typically, the surface layer is very dark brown sandy loam about 7 inches thick. The subsurface layer is very dark brown and very dark grayish brown sandy loam about 12 inches thick. The subsoil is about 11 inches thick. The upper part is brown, very friable sandy loam, and the lower part is yellowish brown, very friable loamy sand that contains some fine gravel. The substratum to a depth of about 60 inches is yellowish brown sand. It has concentrations of fine gravel in the upper part.

Included with this soil in mapping are some small depressional areas of somewhat poorly drained soils that remain wet for long periods. The wetness can interfere with tillage. These soils make up less than 5 percent of the unit.

Permeability is moderately rapid in the upper part of the Flagler soil and very rapid in the lower part. Available water capacity is low. Surface runoff is slow. The surface layer is friable and can be easily tilled throughout a fairly wide range of moisture content, but it tends to crust after hard rains and puddle if tilled when wet. The organic matter content is about 1.5 to 2 percent in the surface layer. The shrink-swell potential is low throughout the soil. The underlying sand and gravel somewhat limit the depth to which the roots of some crops can penetrate. Reaction varies widely in the surface layer as a result of local liming practices. The subsoil is slightly acid or

medium acid. It has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. Many small areas are cropped along with larger areas of adjacent soils that are better suited to crops.

This soil is moderately suited to corn and soybeans, to small grain, and to grasses or legumes for hay and pasture. Droughtiness is a limitation in most years unless rainfall is timely. Also, wind erosion is a hazard during most years. Some areas could be easily irrigated because they are nearly level and commonly are near an adequate water supply. A conservation tillage system that leaves crop residue on the surface and cover crops help to prevent excessive soil loss and conserve moisture during periods of low humidity and high velocity winds. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration and the available water capacity. The soil warms up quickly in the spring, thus stimulating early plant growth.

Some areas are used for pasture and hay. Overgrazing reduces the extent of the protective plant cover and causes deterioration of the plant community. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture and the soil in good condition.

The capability subclass is IIIs.

284B—Flagler sandy loam, 2 to 5 percent slopes. This gently sloping, somewhat excessively drained soil is on alluvial benches. Areas range from 2 to 30 acres in size. They are generally long and narrow, but some are irregularly shaped.

Typically, the surface layer is very dark grayish brown sandy loam about 7 inches thick. The subsurface layer is very dark grayish brown sandy loam about 4 inches thick. The subsoil is about 10 inches thick. The upper part is brown, very friable sandy loam, and the lower part is yellowish brown, very friable loamy sand that contains some fine gravel. The substratum to a depth of about 60 inches is yellowish brown sand and coarse sand that contains some fine gravel.

Permeability is moderately rapid in the upper part of the soil and very rapid in the lower part. Available water capacity is low. Surface runoff is medium. The surface layer is friable and can be easily tilled throughout a fairly wide range of moisture content, but it tends to crust after hard rains and puddle if tilled when wet. The organic matter content is about 1 to 2 percent in the surface layer. The shrink-swell potential is low throughout the soil. The underlying sand and gravel somewhat limit the depth to which the roots of some crops can penetrate. Reaction varies widely in the surface layer as a result of local liming practices. The subsoil is slightly acid or medium acid. It has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. Many small areas are cropped along with large areas of adjacent soils that are better suited to crops.

This soil is moderately suited to corn and soybeans. It is suited to small grain and to grasses or legumes for hay or pasture. If cultivated crops are grown, wind erosion is a hazard. Blowing sand grains sometimes damage newly seeded crops on this soil and on the adjoining soils unless the surface is protected by a plant cover. A conservation tillage system that leaves crop residue on the surface and cover crops help to prevent excessive soil loss. The soil is poorly suited to terracing because ridging the moderately coarse textured material is difficult and because the underlying coarse textured material is too close to the surface. If terraces are built, cuts should not expose the coarse textured material in terrace channels. Droughtiness is a limitation in most years unless rainfall is timely. Yields are affected by the amount and timeliness of rainfall. The soil warms up quickly in the spring, thus stimulating early plant growth, particularly on south- and east-facing slopes. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration and the available water capacity.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet or too dry, however, causes surface compaction, poor tilth, and excessive damage to the plants. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture and the soil in good condition.

The capability subclass is IIIe.

290—Dells silt loam, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on alluvial benches. It is subject to flooding. Areas are irregularly shaped and somewhat elongated and range from 2 to 80 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 9 inches thick. The subsurface layer is grayish brown silt loam about 3 inches thick. The subsoil is about 22 inches thick. The upper part is yellowish brown, friable silt loam mottled with grayish brown and brown, and the lower part is mottled grayish brown and yellowish brown, friable and very friable loam and sandy loam. The substratum to a depth of about 60 inches is strong brown loamy sand.

Included with this soil in mapping are small depressional areas of poorly drained soils. Unless these soils are drained, the wetness can delay tillage. Included soils make up less than 5 percent of the unit.

The Dells soil is moderately permeable in the subsoil and rapidly permeable in the substratum. It has a seasonal high water table. Available water capacity is moderate or high. Surface runoff is slow. The surface

layer is friable and can be easily tilled but tends to crust after hard rains and puddle if tilled when wet. The organic matter content is about 2 to 3 percent in the surface layer. The shrink-swell potential is low or moderate in the upper part of the soil and low in the substratum. Reaction varies widely in the surface layer as a result of local liming practices. The subsoil is dominantly slightly acid or medium acid. It has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is well suited to corn and soybeans, to small grain, and to grasses or legumes for hay or pasture. Droughtiness is a limitation during periods of below normal rainfall. The water table is moderately high in the spring but drops rapidly during the growing season. In some areas tile drainage is beneficial during wet periods, but installing the tile is difficult because of the loose, water-bearing sand and gravel. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay tends to improve soil aeration and tilth. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to trees. A few small areas still support trees. Competing vegetation can be controlled by proper site preparation, by prescribed burning, or by spraying, cutting, or girdling. Seedling mortality and the hazards or limitations that affect planting or harvesting are slight.

The capability subclass is IIw.

354—Aquolls, ponded. These very poorly drained soils are in depressional areas on bottom land and low benches adjacent to the major streams and rivers and in shallow depressional areas on uplands. They are subject to ponding by runoff from adjacent areas. Areas are irregular in shape and range from 3 to 20 acres in size.

Typically, the surface layer is about 10 inches of black silty clay loam or clay loam. The subsurface layer is about 30 inches of black, very dark gray, or dark gray silty clay loam, clay loam, loam, or sandy loam. The substratum to a depth of about 60 inches is very dark gray, dark gray, or gray silty clay loam, clay loam, loam, sandy loam, or loamy sand.

Permeability varies but generally is moderately slow, slow, or very slow. Available water capacity generally is moderate or high. In most areas, either small ponds are evident or the water table is at or near the surface throughout the year. The organic matter content ranges from about 4 to 12 percent.

Most areas are idle or are used as wildlife habitat. These soils generally are suited to wetland wildlife habitat but are unsuited to corn, soybeans, and small grain and to grasses and legumes for hay and pasture. Providing adequate drainage is very difficult because suitable outlets are not available.

The capability subclass is VIIw.

377B—Dinsdale silt loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on convex ridges and side slopes in the uplands. Areas are irregularly shaped and range from 2 to more than 50 acres in size.

Typically, the surface layer is black silt loam about 7 inches thick. The subsurface layer is very dark grayish brown silt loam about 8 inches thick. The subsoil is about 33 inches thick. The upper part is brown, friable silty clay loam, and the lower part is yellowish brown, firm loam. The substratum to a depth of about 60 inches is yellowish brown loam. A stone line separates the loess and the underlying firm glacial till.

Permeability is moderate. Available water capacity is high. Surface runoff is medium. The surface layer is friable and can be easily tilled but tends to crust after hard rains and puddle if tilled when wet. The organic matter content is about 3 to 4 percent in the surface layer. The shrink-swell potential is moderate in the surface soil and the upper part of the subsoil and low in the underlying firm glacial till. Reaction varies widely in the surface layer as a result of local liming practices. The subsoil is medium acid. It has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is well suited to intensive cropping of corn and soybeans, to small grain, and to grasses or legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. A conservation tillage system that leaves crop residue on the surface and terraces help to prevent excessive soil loss. If terraces are built, cuts should not expose the less productive underlying glacial till. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability subclass is IIe.

382—Maxfield silty clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is in broad, shallow drainageways in the uplands. Areas are irregularly shaped and range from 2 to more than 200 acres in size.

Typically, the surface layer is black silty clay loam about 7 inches thick. The subsurface layer is black and very dark gray silty clay loam about 11 inches thick. The subsoil is about 20 inches thick. It is mottled. The upper part is dark gray, friable silty clay loam; the next part is grayish brown, friable silt loam; and the lower part is grayish brown, firm loam. The substratum to a depth of about 60 inches is mottled grayish brown and yellowish brown loam. A stone line separates the loess and the underlying firm glacial till.

This soil is moderately permeable. It has a seasonal high water table. Available water capacity is very high. Surface runoff is slow. The surface layer is friable and can be easily tilled but tends to crust after hard rains and puddle if tilled when wet. The organic matter content is about 6 to 7 percent in the surface layer. The shrink-swell potential is high in the upper part of the soil and low in the lower part. The soil is neutral throughout. The subsoil has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to intensive cropping of corn and soybeans, to small grain, and to grasses or legumes for hay and pasture. If row crops are grown, a drainage system is needed to lower the water table and improve the timeliness of fieldwork. Also, wind erosion is a hazard in areas that are fall plowed and are not protected. A conservation tillage system that leaves crop residue on the surface helps to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

Inadequately drained areas generally are pastured. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability subclass is IIw.

391B—Clyde-Floyd complex, 1 to 4 percent slopes. These very gently sloping and gently sloping soils are in drainageways on glacial uplands. In most places the poorly drained Clyde soil is in the lowest part of the drainageway and has a slope of less than 2 percent. The somewhat poorly drained Floyd soil occurs as bands bordering the Clyde soil and has a slope of 1 to 4 percent. Areas range from 10 to more than 200 acres in size. They are about 50 percent Clyde soil and 35 percent Floyd soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Clyde soil has a surface layer of black clay loam about 8 inches thick. The subsurface layer is black clay loam about 14 inches thick. The subsoil is about 38 inches thick. The upper part is dark gray, friable loam and grayish brown, very friable sandy loam; the next part is mottled strong brown and grayish brown, firm loam; and the lower part is brown, firm loam. The substratum to a depth of about 60 inches is brown, mottled loam.

Typically, the Floyd soil has a surface layer of black loam about 8 inches thick. The subsurface layer is very dark grayish brown loam about 10 inches thick. The subsoil is about 40 inches thick. The upper part is dark grayish brown, friable loam and mottled brown, grayish brown, and yellowish brown, very friable sandy loam; the next part is grayish brown, firm loam; and the lower part is mottled yellowish brown, brown, and grayish brown, firm loam. The substratum to a depth of about 60 inches is brown, mottled loam.

Included with these soils in mapping are small areas of Schley soils and the very poorly drained Palms soils. Palms soils are in depressions. They have an organic matter content of more than 20 percent. Schley soils are more acid than the Clyde and Floyd soils and contain less organic matter. They are on concave side slopes. Palms and Schley soils make up about 10 percent of the unit. Also included are some small areas where installing drainage tile is difficult because bedrock crops out or is at a depth of 2 or 3 feet and small areas where permeability is slower and the shrink-swell potential slightly higher because clayey material is at a depth of 2 to 4 feet. These included areas make up less than 5 percent of the unit.

The Clyde and Floyd soils are moderately permeable. They have a seasonal high water table. Available water capacity is high. Surface runoff is slow. The surface layer is friable and can be easily tilled but tends to crust after hard rains and puddle if tilled when wet. The organic matter content is 7 to 9 percent in the surface layer of the Clyde soil and 5 to 7 percent in the surface layer of the Floyd soil. The shrink-swell potential is moderate in the loamy surficial sediments of both soils and low or moderate in the underlying firm glacial till. The soils are neutral or slightly acid throughout. Their subsoil has a very low supply of available phosphorus and potassium.

Most areas are cultivated. If artificially drained (fig. 9) and protected against runoff from the higher elevations, these soils are well suited to intensive cropping of corn and soybeans, to small grain, and to grasses or legumes for hay and pasture. Gullying is a hazard in areas of concentrated runoff (fig. 10). Grassed waterways help to prevent gully erosion. If row crops are grown, a drainage system is needed to lower the water table and improve the timeliness of fieldwork. Glacial stones and boulders are common in many unimproved, undrained areas. They should be removed before the soils are tile drained and cultivated. A conservation tillage system that leaves crop residue on the surface helps to prevent excessive soil loss. Returning crop residue to the soils or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

Figure 9.—Installing tile in an area of Clyde-Floyd complex, 1 to 4 percent slopes.

Inadequately drained areas generally are pastured. Overgrazing or grazing when the soils are too wet causes surface compaction and poor tilth, reduces the runoff rate, and damages the plant cover. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soils in good condition.

The capability subclass is IIw.

398—Tripoli clay loam, 0 to 2 percent slopes. This nearly level, poorly drained soil is on slightly concave upland divides or at the head of drainageways in the uplands. Areas are irregularly shaped and range from 5 to 100 acres in size.

Typically, the surface layer is black clay loam about 8 inches thick. The subsurface layer is black clay loam about 11 inches thick. The subsoil is about 35 inches thick. It is mottled. The upper part is dark grayish brown, friable loam; the next part is light olive brown, firm loam; and the lower part is yellowish brown and mottled strong brown and grayish brown, firm, calcareous loam. The substratum to a depth of about 60 inches is mottled strong brown and grayish brown loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Readlyn and Watseka soils on the slightly higher parts of the landscape. Readlyn soils are lower in organic matter content than the Tripoli soil and are more acid in the subsoil. Watseka soils contain more sand and less clay than the Tripoli soil and are lower in organic matter content. Included soils make up about 5 to 7 percent of the unit.

The Tripoli soil is moderately permeable. It has a seasonal high water table. Available water capacity is high. Surface runoff is slow. The surface layer is friable and can be easily tilled but tends to crust after hard rains

and puddle if tilled when wet. The organic matter content is about 6 to 7 percent in the surface layer. The shrink-swell potential is moderate in the surface soil and low in the subsoil and substratum. Reaction is neutral in the surface soil, neutral or mildly alkaline in the subsoil, and mildly alkaline in the substratum. The subsoil has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to intensive cropping of corn and soybeans, to small grain, and to grasses or legumes for hay and pasture. If row crops are grown, a drainage system is needed to lower the water table and improve the timeliness of fieldwork. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

Inadequately drained areas generally are pastured. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability subclass is IIw.

399—Readlyn loam, 1 to 3 percent slopes. This very gently sloping, somewhat poorly drained soil is on broad divides or at the slightly concave head of drainageways in the uplands. Areas are irregularly shaped and range from 2 to several hundred acres in size.

Figure 10.—Farm pond in an area of Clyde-Floyd complex, 1 to 4 percent slopes. The pond helps to prevent gullying.

Typically, the surface layer is black loam about 8 inches thick. The subsurface layer is very dark brown and very dark grayish brown loam about 9 inches thick. The subsoil is about 33 inches thick. It is mottled. The upper part is dark grayish brown, friable loam, and the lower part is olive brown and light olive brown, firm loam. The substratum to a depth of about 60 inches is light olive brown loam. In places the surface soil is thinner and has a lower content of organic matter.

Included with this soil in mapping are small areas of the poorly drained Tripoli soils. These soils are in small depressions. They are higher in organic matter content than the Readlyn soil and contain more clay in the surface layer. They make up about 6 to 8 percent of the unit.

The Readlyn soil is moderately permeable. It has a seasonal high water table. Available water capacity is high. Surface runoff is slow or medium. The surface layer is friable and can be easily tilled but tends to crust after hard rains and puddle if tilled when wet. The content of organic matter is about 4 to 5 percent in the surface layer. The shrink-swell potential is low throughout the soil. Reaction varies widely in the surface layer as a result of local liming practices. The subsoil is medium acid in the upper part and slightly acid in the lower part. It has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to intensive cropping of corn and soybeans, to small grain, and to grasses or legumes for hay and pasture. In some areas tile drainage is needed to reduce the wetness and improve the timeliness of fieldwork. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

Some areas are used for pasture and hay. Overgrazing or grazing when the soil is too wet causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability class is I.

407B—Schley loam, 1 to 4 percent slopes. This gently sloping, somewhat poorly drained soil is on glaciated uplands. Areas are irregularly shaped and range from 3 to about 120 acres in size.

Typically, the surface layer is very dark gray loam about 7 inches thick. The subsurface layer is dark grayish brown loam about 6 inches thick. The subsoil is about 32 inches thick. The upper part is brown, friable loam, and the lower part is yellowish brown, firm loam. The substratum to a depth of about 60 inches is brown loam.

Included with this soil in mapping are small areas of soils that have a gravelly loamy sand or loamy sand surface layer. These soils are lower in organic matter content than the Schley soil and have a lower available water capacity. Also included are some areas of soils that are more slowly permeable than the Schley soil because they have clayey material at a depth of 2 to 4 feet. These soils tend to be excessively wet and seepy for extended periods at the base of side slopes. Included soils are in positions on the landscape similar to those of the Schley soil. They make up about 2 to 5 percent of the unit.

The Schley soil is moderately permeable. It has a seasonal high water table. Available water capacity is high. Surface runoff is slow. The surface layer is friable and can be easily tilled but tends to crust after hard rains and puddle if tilled when wet. The organic matter content is about 2 to 3 percent in the surface layer. The shrink-swell potential is moderate in the upper part of the soil and low in the underlying firm glacial till. Reaction varies widely in the surface layer as a result of local liming practices. The subsoil is medium acid or strongly acid. It has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to corn and soybeans, to small grain, and to grasses or legumes for hay or pasture. If row crops are grown, a drainage system is needed to lower the water table and improve the timeliness of fieldwork. Gullying is a hazard in areas of concentrated runoff. Measures that help to control the runoff from the higher elevations are needed. Grassed waterways help to prevent gullying. A conservation tillage system that leaves crop residue on the surface helps to prevent excessive soil loss. Glacial stones and boulders are common in many unimproved areas. They should be removed before the soil is tile drained and cultivated. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

Inadequately drained areas generally are pastured. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth, reduces the runoff rate, and damages the plant cover. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

Some areas remain in native hardwoods. This soil is only moderately suited to trees because it has a seasonal high water table and remains wet for long periods after rainfall. A drainage system is needed to reduce seedling mortality.

The capability subclass is IIw.

408B—Olin fine sandy loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on convex ridgetops and side slopes in the uplands. Areas are irregularly shaped and somewhat oval and range from 3 to 60 acres in size.

Typically, the surface layer is very dark brown fine sandy loam about 7 inches thick. The subsurface layer is very dark brown and very dark grayish brown fine sandy loam about 14 inches thick. The subsoil is about 34 inches thick. The upper part is brown, very friable fine sandy loam, and the lower part is dark yellowish brown and yellowish brown, mottled, firm loam. The substratum to a depth of about 60 inches is mottled yellowish brown and grayish brown loam. A stone line separates the surface sediments from the underlying firm glacial till.

Included with this soil in mapping are small areas of the moderately well drained Kenyon soils in similar positions on the landscape. These soils have a higher available water capacity than the Olin soil. They make up about 6 percent of the unit. Also included are small areas of the somewhat poorly drained Floyd and Schley soils along upland drainageways and small areas of the excessively drained Sparta soils. Floyd and Schley soils contain more clay and less sand in the upper part than the Olin soil and have a higher available water capacity. They make up about 2 percent of the unit. Sparta soils are lower in organic matter content than the Olin soil, have a lower available water capacity, and are more susceptible to wind erosion. They make up about 2 percent of the unit.

Permeability is moderately rapid in the upper part of the Olin soil and moderate in the lower part. Available water capacity is high. Surface runoff is medium. The surface layer is very friable and can be easily tilled throughout a fairly wide range of moisture content, but it tends to crust after hard rains and puddle if tilled when wet. The organic matter content is about 2 percent in the surface layer. The shrink-swell potential is low throughout the soil. Reaction varies widely in the surface layer as the result of local liming practices. The subsoil is slightly acid or medium acid. It has a very low supply of available phosphorus and potassium.

Most areas are cultivated. Many small areas are cropped along with larger areas of adjacent soils that are better suited to crops.

This soil is moderately suited to corn and soybeans, to small grain, and to grasses or legumes for hay or pasture. If cultivated crops are grown, wind erosion is a hazard. Blowing sand grains sometimes damage newly seeded crops on this soil and on the adjoining soils unless the surface is protected by a plant cover. A conservation tillage system that leaves crop residue on the surface and cover crops help to prevent excessive soil loss. The soil is not well suited to terracing because ridging the moderately coarse textured material is difficult and because the less productive underlying glacial till is too close to the surface. If terraces are built, cuts should not expose the glacial till. Droughtiness is a limitation unless rainfall is timely. Yields are affected by the amount and timeliness of rainfall. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet or too dry, however, causes surface compaction, poor tilth, and excessive damage to the plants. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture and the soil in good condition.

The capability subclass is IIe.

408C—Olin fine sandy loam, 5 to 9 percent slopes. This moderately sloping, well drained soil is on short, convex side slopes in the uplands. Areas generally are long and narrow. They range from 3 to 15 acres in size.

Typically, the surface layer is very dark brown fine sandy loam about 7 inches thick. The subsurface layer is very dark grayish brown fine sandy loam about 5 inches thick. The subsoil is about 26 inches thick. The upper part is brown, very friable fine sandy loam, and the lower part is dark yellowish brown and yellowish brown, firm loam. The substratum to a depth of about 60 inches is mottled yellowish brown and grayish brown loam. A stone line separates the surface sediments from the underlying firm glacial till.

Included with this soil in mapping are small areas of the excessively drained Sparta soils in similar positions on the landscape. These soils make up about 3 percent of the unit. Also included are small areas where the available water capacity is lower because glacial till is at a depth of more than 40 inches. These included areas make up about 2 percent of the unit.

Permeability is moderately rapid in the upper part of the Olin soil and moderate in the lower part. Available water capacity is high. Surface runoff is medium. The surface layer is very friable and can be easily tilled throughout a fairly wide range of moisture content, but it tends to crust after hard rains and puddle if tilled when wet. The organic matter content is about 1 percent in the surface layer. The shrink-swell potential is low throughout the soil. Reaction varies widely in the surface layer as a result of local liming practices. The subsoil is slightly acid or medium acid. It has a very low supply of available phosphorus and potassium.

Most areas are cultivated. Many small areas are cropped along with larger areas of adjacent soils that are better suited to crops.

This soil is moderately suited to corn and soybeans, to small grain, and to grasses or legumes for hay or pasture. If cultivated crops are grown, wind erosion is a hazard. Blowing sand grains sometimes damage newly seeded crops on this soil and on the adjoining soils unless the surface is protected by a plant cover. A conservation tillage system that leaves crop residue on the surface and cover crops help to prevent excessive soil loss. The soil is not well suited to terracing because

ridging the moderately coarse textured material is difficult and because the less productive underlying glacial till is too close to the surface. If terraces are built, cuts should not expose the glacial till. Droughtiness is a limitation unless rainfall is timely. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing and grazing when the soil is too wet or too dry, however, causes surface compaction, poor tilth, and excessive damage to plants. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture and the soil in good condition.

The capability subclass is IIIe.

412C—Sogn loam, 2 to 9 percent slopes. This gently sloping and moderately sloping, somewhat excessively drained soil is on convex ridges and short side slopes in the uplands. Areas are irregularly shaped and somewhat elongated and range from 2 to 20 acres in size.

Typically, the surface layer is very dark brown loam about 7 inches thick. The subsurface layer is very dark grayish brown loam about 11 inches thick. Fractured limestone bedrock is at a depth of about 18 inches.

Included with this soil in mapping are small areas of soils that have a loamy sand or sand surface layer. These soils are lower in organic matter content than the Sogn soil, have a lower available water capacity, and are more susceptible to wind erosion in areas that are not protected. They are in similar positions on the landscape. They make up about 3 percent of the unit. Also included are small areas of exposed bedrock, which interferes with tillage. These areas are in positions on the landscape similar to those of the Sogn soil. They make up about 2 percent of the unit.

Permeability is moderate in the Sogn soil. Available water capacity is low or very low. Surface runoff is medium or rapid. The organic matter content is about 2 to 3 percent in the surface layer. The shrink-swell potential is moderate throughout the soil. The root zone is limited by the limestone bedrock. The surface soil is neutral. It has a very low supply of available phosphorus and potassium.

Some small areas are cropped along with larger areas of adjacent soils that are better suited to crops. This soil is unsuited to corn and soybeans and to small grain. It is better suited to grasses and legumes for hay or pasture. Droughtiness is a severe limitation.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth and damages the plant cover. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is poorly suited to trees, but some areas support native hardwoods. Plant competition is moderate. It can be controlled by proper site preparation, by prescribed burning, or by spraying, cutting, or girdling. Seedling mortality and the hazards or limitations that affect planting or harvesting are slight.

The capability subclass is VIIs.

471—Oran loam, 1 to 3 percent slopes. This very gently sloping, somewhat poorly drained soil is on glacial uplands. Areas are irregularly shaped and range from 2 to several hundred acres in size.

Typically, the surface layer is very dark gray loam about 7 inches thick. The subsurface layer is dark grayish brown loam about 3 inches thick. The subsoil is about 46 inches thick. The upper part is brown and grayish brown, friable and firm loam; the next part is mottled strong brown and light brownish gray, firm loam; and the lower part is strong brown, mottled, firm loam. The substratum to a depth of about 60 inches is strong brown, mottled loam.

Included with this soil in mapping are small areas of soils that have a loamy sand surface layer. These soils are lower in organic matter content than the Oran soil and have a lower available water capacity. They are on mounds. They make up about 3 percent of the unit. Also included are small areas of poorly drained soils in depressions. These soils make up about 2 percent of the unit.

The Oran soil is moderately permeable. It has a seasonal high water table. Available water capacity is high. Surface runoff is slow or medium. The surface layer is friable and can be easily tilled but tends to crust after hard rains and puddle if tilled when wet. The organic matter content is about 2 to 3 percent in the surface layer. The shrink-swell potential is low throughout the soil. Reaction varies widely in the surface layer as a result of local liming practices. The subsoil is dominantly medium acid or strongly acid. It has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to intensive cropping of corn and soybeans, to small grain, and to grasses or legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. A conservation tillage system that leaves crop residue on the surface helps to prevent excessive soil loss. In some areas tile drainage is needed to reduce the wetness and improve the timeliness of fieldwork. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay improves soil aeration and tilth. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation,

timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is only moderately suited to trees because it has a seasonal high water table and remains wet for long periods after rainfall. A drainage system is needed to reduce seedling mortality. Special equipment is needed because equipment limitations are moderate.

The capability class is I.

485—Spillville loam, 0 to 2 percent slopes. This nearly level, moderately well drained or somewhat poorly drained soil is on flood plains and along intermittent streams. It is subject to flooding. Areas are somewhat long and narrow and range from 4 to about 35 acres in size.

Typically, the surface layer is black loam about 7 inches thick. The subsurface layer is black, very dark brown, and dark brown loam about 33 inches thick. The upper part of the substratum is brown sandy loam. The lower part to a depth of about 60 inches is yellowish brown loamy sand.

Included with this soil in mapping are some small areas of soils that have a sandy loam surface layer. These soils are lower in organic matter content than the Spillville soil and have a lower available water capacity. They are in similar landscape positions or are on the slightly higher mounds. They make up about 4 percent of the unit.

The Spillville soil is moderately permeable. It has a seasonal high water table. Available water capacity is high or very high. Surface runoff is slow. The surface layer is friable and can be easily tilled. The organic matter content is about 4 to 5 percent in the surface layer. The shrink-swell potential is moderate in the surface soil and low in the substratum. The soil is neutral or slightly acid throughout. It has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is well suited to intensive cropping of corn and soybeans, to small grain, and to grasses or legumes for hay or pasture. Returning crop residue to the soil or regularly adding other organic material improves fertility and increases the rate of water infiltration.

Some areas are used for pasture or hay. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability subclass is IIw.

499B—Nordness loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on convex ridges and short side slopes in the uplands. Areas are irregularly shaped and range from 2 to 25 acres in size.

Typically, the surface layer is very dark gray loam about 7 inches thick. The subsurface layer is brown loam about 2 inches thick. The subsoil is about 11 inches thick. The upper part is yellowish brown, friable loam; the next part is dark yellowish brown, firm clay loam; and the lower part is brown, firm clay. Fractured limestone bedrock is at a depth of about 20 inches.

Permeability is moderate. Available water capacity is very low. Surface runoff is medium. The soil tends to crust after hard rains and puddle if tilled when wet. The organic matter content is about 2 percent in the surface layer. The shrink-swell potential is low in the surface soil and high in the subsoil. The root zone is limited by the limestone bedrock. The upper part of the subsoil is medium acid. The supply of available phosphorus and potassium is very low.

Some areas are cultivated. This soil is poorly suited to corn and soybeans and to small grain. It is better suited to grasses and legumes for hay and pasture. Droughtiness is a severe limitation. Also, erosion is a hazard if cultivated crops are grown. A conservation tillage system that leaves crop residue on the surface helps to prevent excessive soil loss. Tillage is difficult because the soil is shallow to bedrock and limestone slabs are at the surface. Returning crop residue to the soil or regularly adding other organic material improves fertility and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth and damages the plant cover. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is poorly suited to trees. Some areas remain in native hardwoods. Seedling mortality is severe because of the shallowness to limestone bedrock. The hazards or limitations that affect planting or harvesting are moderate.

The capability subclass is IVs.

499D—Nordness loam, 5 to 14 percent slopes. This moderately sloping and strongly sloping, well drained soil is on short side slopes in the uplands. Areas are long and narrow and range from 2 to 10 acres in size.

Typically, the surface layer is very dark gray loam about 7 inches thick. The subsurface layer is brown loam about 2 inches thick. The subsoil is about 11 inches thick. The upper part is yellowish brown, friable loam; the next part is dark yellowish brown, firm clay loam; and the lower part is brown, firm clay. Fractured limestone bedrock is at a depth of about 20 inches (fig. 11).

Permeability is moderate. Available water capacity is very low. Surface runoff is medium or rapid. The soil tends to crust after hard rains and puddle if tilled when wet. The organic matter content is about 1 to 2 percent

Figure 11.—An area of Nordness loam, 5 to 14 percent slopes. This soil is a good source of limestone.

in the surface layer. The shrink-swell potential is low in the surface soil and high in the subsoil. The root zone is limited by the limestone bedrock. The subsoil is medium acid. The supply of available phosphorus and potassium is very low.

Some areas are cultivated. This soil is generally unsuited to small grain but is moderately suited to grasses and legumes for hay or pasture. Droughtiness is a severe limitation. Also, erosion is a hazard if cultivated crops are grown. A conservation tillage system that leaves crop residue on the surface helps to prevent excessive soil loss. Tillage is difficult because the soil is shallow to bedrock and limestone slabs are at the surface. Returning crop residue to the soil or regularly adding other organic material improves fertility and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth and damages the plant cover. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is poorly suited to trees. Some areas remain in native hardwoods. Seedling mortality is severe because of the shallowness to limestone bedrock. The hazards or limitations that affect planting or harvesting are moderate.

The capability subclass is VIs.

499F—Nordness loam, 14 to 30 percent slopes. This moderately steep to very steep, well drained soil is on short side slopes on uplands and escarpments. Areas are long and narrow and range from 2 to 10 acres in size.

Typically, the surface layer is black loam about 3 inches thick. The subsurface layer is brown loam about 2 inches thick. The subsoil is about 11 inches thick. The

upper part is yellowish brown, friable loam; the next part is dark yellowish brown, firm clay loam; and the lower part is brown, firm clay. Fractured limestone bedrock is at a depth of about 16 inches.

Included with this soil in mapping are some areas of Chelsea soils in similar positions on the landscape. These soils are slightly lower in organic matter content than the Nordness soil and do not have limestone bedrock within a depth of 48 inches. They make up about 3 percent of the unit.

Permeability is moderate in the Nordness soil. Available water capacity is very low. Surface runoff is rapid. The soil tends to crust after hard rains and puddle if tilled when wet. The organic matter content is about 1 percent in the surface layer. The shrink-swell potential is low in the surface soil and high in the subsoil. The root zone is limited by the limestone bedrock. The upper part of the subsoil is medium acid. The supply of available phosphorus and potassium is very low.

Most areas are used for trees or as wildlife habitat. Some small areas are permanent pasture. This soil is generally unsuited to cultivated crops. It is extremely limited as a site for other farm uses. Renovating pasture is difficult because of the shallowness to bedrock. Ordinary farm machinery cannot be used because limestone slabs are at the surface and slopes generally are too steep. The number of livestock that can graze the pasture without damaging the plant cover is low. As a result, controlled grazing is needed.

This soil is poorly suited to trees. Most areas remain in native hardwoods. Seedling mortality is severe because of the shallowness to limestone bedrock. The hazards or limitations that affect planting or harvesting are moderate.

The capability subclass is VIIs.

585—Spillville-Coland complex, 0 to 2 percent slopes. These nearly level, somewhat poorly drained and poorly drained soils are on alluvial flood plains along the major streams and some of their tributaries. They are subject to flooding (fig. 12). Areas are irregularly shaped and range from 2 to more than 100 acres in size. They are about 53 percent Spillville soil and 43 percent Coland soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Spillville soil has a surface layer of black loam about 8 inches thick. The subsurface layer is black, very dark brown, and dark brown loam about 32 inches thick. The upper part of the substratum is brown, mottled sandy loam. The lower part to a depth of about 60 inches is yellowish brown, mottled loamy sand.

Typically, the Coland soil has a surface layer of black clay loam about 11 inches thick. The subsurface layer is black and very dark gray clay loam about 37 inches thick. The substratum to a depth of about 60 inches is dark gray clay loam mottled with brown.

Included with these soils in mapping are small areas of the poorly drained Marshan soils in depressions. These included soils have a clay loam surface layer and are underlain by sand and gravel within a depth of 40 inches. They make up about 4 percent of the unit.

The Spillville and Coland soils are moderately permeable. They have a seasonal high water table. Available water capacity is high. Surface runoff is slow. The organic matter content is about 4 to 7 percent in the surface layer. The shrink-swell potential is moderate in the upper part of the Spillville soil and high in the Coland soil. Both soils are neutral or slightly acid throughout. Their subsurface layer has a low supply of available phosphorus and a very low supply of available potassium.

Some areas are used for cultivated crops. The Coland soil is moderately suited to row crops. The Spillville soil is well suited to intensive row cropping. Yields vary because of the difficulty in draining wet areas and in providing flood protection and because of variations in the available water capacity. Installing a tile drainage system and establishing levees in some areas increase crop production.

These soils dominantly are used for permanent pasture. Overgrazing or grazing when the soils are too wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability subclass is IIw.

663B—Seaton silt loam, 2 to 5 percent slopes. This gently sloping, well drained soil is on convex, narrow ridgetops and side slopes in the uplands. Areas generally are long and narrow or irregularly shaped and range from 10 to 40 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsoil is friable silt loam about 50 inches thick. The upper part is dark yellowish brown; the next part is dark yellowish brown and is mottled with strong brown and brownish yellow; and the lower part is yellowish brown and is mottled with grayish brown. The substratum to a depth of about 60 inches is dark yellowish brown, mottled silt loam.

Permeability is moderate. Available water capacity is high. Surface runoff is medium. The surface layer is friable and can be easily tilled but tends to crust after hard rains and puddle if tilled when wet. The organic matter content is about 2 to 3 percent in the surface layer. The shrink-swell potential is low throughout the soil. Reaction varies widely in the surface layer as a result of local liming practices. The subsoil is medium acid or strongly acid. It has a high supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is well suited to intensive cropping of corn and soybeans, to small grain,

Figure 12.—An area of Spillville-Coland complex, 0 to 2 percent slopes, along the Wapsipinicon River in Independence. These soils are subject to flooding.

and to grasses or legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. A conservation tillage system that leaves crop residue on the surface, contour farming, and terraces help to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to trees. Some small areas remain in native hardwoods. Competing vegetation can be controlled by proper site preparation, by prescribed burning, or by spraying, cutting, or girdling. Seedling mortality and the hazards or limitations that affect planting or harvesting are slight.

The capability subclass is IIe.

663C2—Seaton silt loam, 5 to 14 percent slopes, moderately eroded. This moderately sloping and strongly sloping, well drained soil is on convex, narrow ridgetops and side slopes in the uplands. Areas generally are long and narrow or irregularly shaped and range from 10 to 40 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsoil is friable silt loam about 44 inches thick. The upper part is dark yellowish brown; the next part is dark yellowish brown and mottled;

and the lower part is yellowish brown and mottled. The substratum to a depth of about 60 inches is dark yellowish brown, mottled silt loam.

Permeability is moderate. Available water capacity is high. Surface runoff is medium. The surface layer is friable and can be easily tilled but tends to crust after hard rains and puddle if tilled when wet. The organic matter content is about 1 to 2 percent in the surface layer. The shrink-swell potential is low throughout the soil. Reaction in the surface layer varies widely as a result of local liming practices. The subsoil is medium acid or strongly acid. It has a high supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is moderately suited to corn and soybeans, to small grain, and to grasses or legumes for hay and pasture. If cultivated crops are grown, further erosion is a hazard. A conservation tillage system that leaves crop residue on the surface, terraces, and contour farming help to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to trees. Some small areas remain in native hardwoods. Competing vegetation can be controlled by proper site preparation, by prescribed burning, or by spraying, cutting, or girdling. Seedling mortality and the hazards or limitations that affect planting or harvesting are slight.

The capability subclass is IIIe.

663F—Seaton silt loam, 14 to 30 percent slopes. This moderately steep to very steep, well drained soil is on convex, narrow ridgetops and side slopes in the uplands. Areas are long and narrow and range from 10 to 40 acres in size.

Typically, the surface layer is very dark gray silt loam about 4 inches thick. The subsurface layer is dark grayish brown silt loam about 2 inches thick. The subsoil is friable silt loam about 42 inches thick. The upper part is dark yellowish brown; the next part is dark yellowish brown and mottled; and the lower part is yellowish brown and mottled. The substratum to a depth of about 60 inches is dark yellowish brown, mottled silt loam.

Included with this soil in mapping are a few small areas of soils that have a loamy sand or sand surface layer. These soils are slightly lower in organic matter content than the Seaton soil and have a lower available water capacity. They are in similar positions on the landscape. They make up about 2 percent of the unit. Also included are some areas of soils in which the plow layer is mostly subsoil material. These soils are lower in organic matter content than the Seaton soil. They are in similar positions on the landscape. They make up about 2 percent of the unit.

Permeability is moderate in the Seaton soil. Available water capacity is high. Surface runoff is medium or rapid. The surface layer is friable and can be easily tilled but tends to crust after hard rains and puddle if tilled when wet. The organic matter content is about 1 to 2 percent in the surface layer. The shrink-swell potential is low throughout the soil. The subsoil is medium acid or strongly acid. It has a high supply of available phosphorus and a very low supply of available potassium.

Some areas are cultivated. This soil generally is unsuitable for row crops. It is moderately suited to grasses and legumes for hay and pasture. If cultivated crops are grown, erosion is a severe hazard. A conservation tillage system that leaves crop residue on the surface, terraces, and contour farming help to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to trees. Some areas remain in native hardwoods. Special equipment is needed because of the moderately steep to very steep slopes. Competing vegetation can be controlled by proper site preparation, by prescribed burning, or by spraying, cutting, or girdling. Seedling mortality and the hazards or limitations that affect planting or harvesting are moderate.

The capability subclass is VIe.

725—Hayfield loam, 24 to 32 inches to sand and gravel, 0 to 2 percent slopes. This nearly level, somewhat poorly drained soil is on alluvial terraces. Areas are irregularly shaped and range from 5 to more than 100 acres in size.

Typically, the surface layer is very dark grayish brown loam about 6 inches thick. The subsurface layer is very dark grayish brown and dark grayish brown loam about 6 inches thick. The subsoil is about 18 inches thick. The upper part is brown, friable loam; the next part is brown, mottled, friable loam; and the lower part is dark yellowish brown, mottled, friable sandy loam. The substratum to a depth of about 60 inches is yellowish brown, mottled sand.

This soil is moderately permeable in the subsoil and rapidly permeable in the substratum. It has a seasonal high water table. Available water capacity is low. Surface runoff is slow. The surface layer is friable and can be easily tilled but tends to crust after hard rains and puddle if tilled when wet. The organic matter content is about 2 to 3 percent in the surface layer. The shrink-swell potential is low throughout the soil. Reaction in the surface layer varies as a result of local liming practices. The subsoil is neutral to medium acid. It has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is moderately suited to corn and soybeans, to small grain, and to grasses or legumes for hay or pasture. Droughtiness is a limitation during periods of below normal rainfall. The water table is moderately high in the spring but drops rapidly during the growing season. In some areas tile drainage is beneficial during wet periods, but installing the tile is difficult because of the loose, water-bearing sand and gravel. If cultivated crops are grown, wind erosion is a hazard in areas that are fall plowed and are not protected. A conservation tillage system that leaves crop residue on the surface helps to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay improves soil aeration and tilth. Overgrazing or grazing when the soil is too wet, however, causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to trees. A few small areas remain in native hardwoods. Competing vegetation can be controlled by proper site preparation, by prescribed burning, or by spraying, cutting, or girdling. Seedling mortality and the hazards or limitations that affect planting or harvesting are slight.

The capability subclass is IIs.

761—Franklin silt loam, 1 to 3 percent slopes. This very gently sloping, somewhat poorly drained soil is on upland divides and slightly convex side slopes in the uplands. Areas are irregularly shaped and range from 2 to 150 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is dark grayish brown and grayish brown silt loam about 6 inches thick. The subsoil is about 33 inches thick. The upper part is grayish brown, mottled, friable silty clay loam, and the lower part is mottled light brownish gray and yellowish brown, firm loam. The substratum to a depth of about 60 inches is mottled light brownish gray and yellowish brown loam. A stone line separates the loess from the underlying firm glacial till.

This soil is moderately permeable. It has a seasonal high water table. Available water capacity is high. Surface runoff is slow or medium. The surface layer is friable and can be easily tilled but crusts after hard rains and puddles if tilled when wet. The organic matter content is about 2 to 3 percent in the surface layer. The shrink-swell potential is moderate in the upper part of the soil and low in the underlying firm glacial till. Reaction varies widely in the surface layer as a result of local liming practices. The subsoil is strongly acid. It has a low supply of available phosphorus and a very low supply of available potassium.

Most areas are cultivated. This soil is well suited to intensive cropping of corn and soybeans, to small grain, and to grasses or legumes for hay and pasture. A conservation tillage system that leaves crop residue on the surface helps to prevent excessive soil loss. In some areas tile drainage is needed to reduce the wetness and improve the timeliness of fieldwork. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is well suited to trees. A few small areas remain in native hardwoods. Competing vegetation can be controlled by proper site preparation, by prescribed burning, or by spraying, cutting, or girdling. Seedling mortality and the hazards or limitations that affect planting or harvesting are slight.

The capability class is I.

776—Lilah sandy loam, 0 to 2 percent slopes. This nearly level, excessively drained soil is on alluvial benches. Areas are irregularly shaped and range from 10 to 100 acres in size.

Typically, the surface layer is very dark grayish brown sandy loam about 8 inches thick. The subsurface layer is brown sandy loam about 5 inches thick. The subsoil is about 15 inches thick. The upper part is brown, very friable sandy loam, and the lower part is strong brown, loose loamy sand. The substratum to a depth of about 60 inches is yellowish brown and light yellowish brown sand.

Permeability is very rapid. Available water capacity is very low. Surface runoff is slow. The surface layer is friable and can be easily tilled throughout a fairly wide range of moisture content, but it tends to crust after hard rains and puddle if tilled when wet. The organic matter content is about 0.5 to 1 percent in the surface layer. The shrink-swell potential is low in the upper part of the soil and very low in the lower part. Reaction varies

widely in the surface layer as a result of local liming practices. The subsoil is strongly acid or very strongly acid. It has a very low supply of available phosphorus and potassium.

Most areas are cultivated. Many small areas are cropped along with larger areas of adjacent soils that are better suited to crops.

This soil is poorly suited to corn and soybeans. It is better suited to small grain and to grasses or legumes for hay or pasture. Droughtiness is a severe limitation in most years unless rainfall is timely. Also, wind erosion is a hazard during most years. A conservation tillage system that leaves crop residue on the surface and cover crops help to prevent excessive soil loss and conserve moisture. The soil warms up quickly in the spring, thus stimulating early plant growth. Returning crop residue to the soil or regularly adding other organic material improves fertility and increases the rate of water infiltration and the available water capacity.

Some areas are used for pasture or hay. Overgrazing and grazing when the soil is too wet or too dry reduce the extent of the plant cover and cause deterioration of the plant community. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture and the soil in good condition.

This soil is moderately suited to trees. A few small areas remain in native hardwoods. Seedling mortality is severe because the soil is droughty. Supplemental water is needed in some areas. The hazards or limitations that affect planting or harvesting are slight.

The capability subclass is IVs.

776C—Lilah sandy loam, 2 to 9 percent slopes. This gently sloping and moderately sloping, excessively drained soil is on alluvial benches and on uplands. Areas generally are long and narrow and range from 2 to 20 acres in size.

Typically, the surface layer is very dark grayish brown sandy loam about 7 inches thick. The subsoil is about 15 inches thick. The upper part is brown, very friable sandy loam, and the lower part is strong brown, loose loamy fine sand. The substratum to a depth of about 60 inches is yellowish brown and light yellowish brown sand. In places the surface layer is loamy sand or brown sandy loam.

Permeability is very rapid. Available water capacity is very low. Surface runoff is slow. The surface layer is friable and can be easily tilled throughout a fairly wide range of moisture content, but it tends to crust after hard rains and puddle if tilled when wet. The organic matter content is less than 0.5 percent in the surface layer. The shrink-swell potential is low in the upper part of the soil and very low in the lower part. Reaction varies widely in the surface layer as a result of local liming practices. The subsoil is strongly acid or very strongly acid. It has a very low supply of available phosphorus and potassium.

Some areas are cultivated. Some small areas are cropped along with larger areas of adjacent soils that are better suited to crops.

This soil is poorly suited to corn and soybeans. It is better suited to small grain and to grasses or legumes for hay or pasture. Droughtiness is a severe limitation in most years unless rainfall is timely. Also, wind erosion is a hazard if cultivated crops are grown. Blowing sand grains sometimes damage newly seeded crops on this soil and on the adjoining soils unless the surface is protected by a plant cover. A conservation tillage system that leaves crop residue on the surface and cover crops help to prevent excessive soil loss. The soil warms up quickly in the spring, thus stimulating early plant growth. Returning crop residue to the soil or regularly adding other organic material improves fertility and increases the rate of water infiltration and the available water capacity.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet or too dry, however, reduces the extent of the plant cover and causes deterioration of the plant community. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture and the soil in good condition.

This soil is moderately suited to trees. A few small areas remain in native hardwoods. Seedling mortality is severe because the soil is droughty. Supplemental water is needed in some areas. The hazards or limitations that affect planting or harvesting are slight.

The capability subclass is IVs.

777—Wapsie loam, 0 to 2 percent slopes. This nearly level, well drained soil is on alluvial terraces. Areas are irregularly shaped and range from 2 to more than 100 acres in size.

Typically, the surface layer is very dark grayish brown loam about 7 inches thick. The subsurface layer is brown loam about 3 inches thick. The subsoil is brown, friable loam about 17 inches thick. The substratum to a depth of about 60 inches is brown gravelly coarse sand.

Included with this soil in mapping are small areas of soils that have a loamy sand or gravelly loamy sand surface layer. These soils are lower in organic matter content than the Wapsie soil and have a lower available water capacity. They are on the slightly higher mounds. They make up about 5 percent of the unit. Also included are small, slightly depressional areas of poorly drained soils that remain wet for long periods. The wetness delays tillage unless a drainage system is installed. These poorly drained soils make up about 3 percent of the unit.

Permeability is moderate in the upper part of the Wapsie soil and very rapid in the substratum. Available water capacity is low or moderate. Surface runoff is slow. The surface layer is friable and can be easily tilled

but tends to crust after hard rains and puddle if tilled when wet. The organic matter content is about 1 to 2 percent in the surface layer. The shrink-swell potential is low throughout the soil. The underlying sand and gravel somewhat limit the depth to which the roots of some crops can penetrate. Reaction varies widely in the surface layer as a result of local liming practices. The subsoil is medium acid. It has a low or very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is moderately suited to corn and soybeans, to small grain, and to grasses or legumes for hay or pasture. Droughtiness is a limitation in most years unless rainfall is timely. Also, wind erosion is a hazard in areas that are fall plowed and are not protected. A conservation tillage system that leaves crop residue on the surface helps to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

Some areas are used for pasture or hay. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is moderately suited to trees. A few areas remain in native hardwoods. Competing vegetation can be controlled by proper site preparation, by prescribed burning, or by spraying, cutting, or girdling. Seedling mortality and the hazards or limitations that affect planting or harvesting are slight.

The capability subclass is IIs.

782B—Donnan loam, 2 to 6 percent slopes. This gently sloping and moderately sloping, moderately well drained and somewhat poorly drained soil is on convex ridges and side slopes in the uplands. Areas are irregularly shaped and range from 2 to 80 acres in size.

Typically, the surface layer is very dark gray loam about 9 inches thick. The subsurface layer is dark grayish brown loam about 5 inches thick. The subsoil is about 34 inches thick. It is mottled. The upper part is brown, friable loam; the next part is grayish brown and light brownish gray, extremely firm clay; and the lower part is light brownish gray, very firm clay loam. The substratum to a depth of about 60 inches is mottled olive brown and light brownish gray clay loam.

This soil is moderately permeable in the upper part and very slowly permeable in the lower part. It has a seasonal high water table. Available water capacity is moderate or high. Surface runoff is medium. The surface layer is friable and can be easily tilled but tends to crust after hard rains and puddle if tilled when wet. The organic matter content is about 2 to 3 percent in the surface layer. The shrink-swell potential is low in the upper part of the soil and moderate or high in the lower part. The clayey subsoil somewhat limits the depth to which the roots of some crops can penetrate (fig. 13). Reaction varies widely in the surface layer as a result of local liming practices. The subsoil is medium acid or strongly acid. It has a very low supply of available phosphorus and potassium.

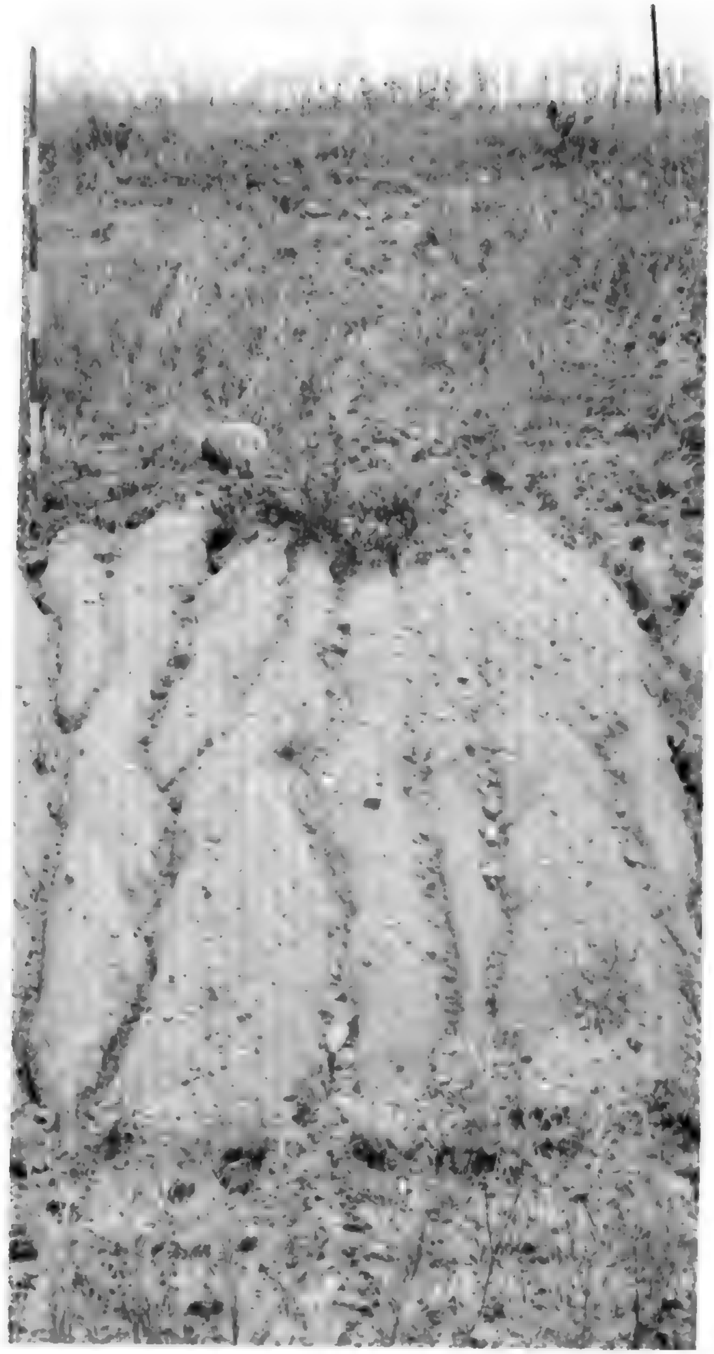

Figure 13.—An area of Donnan loam, 2 to 6 percent slopes. Establishing vegetation is difficult on exposures of gray, highly leached glacial till.

Most areas are cultivated. Many small areas are cropped along with larger areas of adjacent soils that are better suited to crops.

This soil is moderately suited to corn and soybeans, to small grain, or to legumes for hay. It is better suited to grasses and legumes for pasture. If cultivated crops are grown, erosion is a hazard unless the surface is protected by a plant cover. Also, wetness is a limitation. Measures that control erosion tend to increase the wetness because they retard the movement of surface water. As a result, a combination of terraces and tile drainage is needed. In areas where a perched water table and seepage on side slopes are the major problems, a tile drainage system that is designed to intercept water is most likely to be successful. Because of the very slow permeability in the clayey part of the subsoil, installing tile is difficult and all areas cannot be drained satisfactorily. If possible, tile drains should be installed above the clayey part of the subsoil. If terraces are built, cuts should not expose the less productive clayey part of the subsoil. A conservation tillage system that leaves a protective amount of crop residue on the surface helps to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility and helps to prevent surface crusting.

A cover of pasture plants is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

This soil is moderately suited to trees. A few small areas remain in native hardwoods. Competing vegetation can be controlled by proper site preparation, by prescribed burning, or by spraying, cutting, or girdling. Seedling mortality is slight. In areas where the trees are planted or harvested, the hazard of erosion also is slight.

The capability subclass is IIe.

798B—Protivin loam, 1 to 4 percent slopes. This very gently sloping and gently sloping, somewhat poorly drained soil is on uplands. Areas generally are crescent shaped and range from 3 to 25 acres in size.

Typically, the surface layer is black loam about 8 inches thick. The subsurface layer is black and very dark grayish brown loam about 6 inches thick. The subsoil is about 37 inches thick. The upper part is dark grayish brown, firm loam mottled with yellowish brown; the next part is mottled yellowish brown, strong brown, and dark grayish brown, very firm clay loam that has nearly continuous grayish brown coatings; and the lower part is mottled grayish brown and strong brown, very firm clay loam. The substratum to a depth of about 60 inches is mottled grayish brown and yellowish brown clay loam. A stone line separates the loamy surficial sediments and the underlying very firm glacial till.

Included with this soil in mapping are some small areas of the extremely firm Donnan soils on convex ridges and side slopes. These very slowly permeable soils tend to be seepy at the base of the slopes. They make up about 4 percent of the unit.

The Protivin soil is moderately permeable in the upper part and moderately slowly permeable in the lower part. It has a seasonal high water table. Available water capacity is high. Surface runoff is medium. The surface layer is friable and can be easily tilled but tends to crust after hard rains and puddle if tilled when wet. The organic matter content is about 5 percent in the surface layer. The shrink-swell potential is moderate throughout the soil. Reaction varies widely in the surface layer as a result of local liming practices. The subsoil is medium acid to neutral. It has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is moderately suited to intensive cropping of corn and soybeans, to small grain, and to grasses or legumes for hay and pasture. If row crops are grown, a drainage system is needed to lower the water table and improve the timeliness of fieldwork. A combination of terraces and drainage tile is needed in some areas both to control erosion and to reduce the wetness. A conservation tillage system that leaves crop residue on the surface helps to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

Inadequately drained areas generally are pastured. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability subclass is IIw.

807B—Schley Variant sandy loam, 1 to 4 percent slopes. This very gently sloping and gently sloping, somewhat poorly drained soil is on glaciated uplands. Areas are long and narrow and irregularly shaped and range from 10 to 50 acres in size.

Typically, the surface layer is very dark grayish brown sandy loam about 8 inches thick. The subsoil is about 29 inches thick. The upper part is brown, mottled, friable sandy loam; the next part is mottled grayish brown, brown, and dark yellowish brown, friable sandy loam; and the lower part is mottled light brownish gray and brown, very friable loamy sand. The upper part of the substratum is brown, loose fine sand. The lower part to a depth of about 60 inches is yellowish brown loam.

Included with this soil in mapping are some areas of soils that have a loamy sand surface layer. These soils

are lower in organic matter content than the Schley Variant soil, have a lower available water capacity, and are more susceptible to wind erosion. They are in similar positions on the landscape. They make up about 3 percent of the unit.

The Schley Variant soil is rapidly permeable in the subsoil and moderately permeable in the substratum. It has a seasonal high water table. Available water capacity is moderate. Surface runoff is slow. The surface layer is friable and can be easily tilled throughout a wide range of moisture content, but it tends to crust after hard rains and puddle if tilled when wet. The organic matter content is about 1 to 2 percent in the surface layer. The shrink-swell potential is low throughout the soil. Reaction varies widely in the surface layer as a result of local liming practices. The subsoil is medium acid or strongly acid. It has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to corn and soybeans, to small grain, and to grasses or legumes for hay or pasture. If row crops are grown, a drainage system is needed to lower the water table and improve the timeliness of fieldwork. Also, wind erosion is a hazard in cultivated areas. Blowing sand grains sometimes damage newly seeded crops on this soil and on the adjoining soils unless the surface is protected by a plant cover. Gully erosion is a hazard in areas of concentrated runoff. A combination of terraces and drainage tile is needed in some areas both to control erosion and to reduce the wetness. The soil is not well suited to terracing, however, because ridging the moderately coarse textured material is difficult and because the underlying coarse textured material is too close to the surface. If terraces are built, cuts should not expose the coarse textured material in terrace channels. A conservation tillage system that leaves crop residue on the surface and winter cover crops help to prevent excessive soil loss. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

Inadequately drained areas generally are pastured. Overgrazing or grazing when the soil is too wet causes surface compaction and excessive runoff and damages the plant cover. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

Some areas remain in native hardwoods. This soil is only moderately suited to trees because it has a seasonal high water table. Special equipment is needed because equipment limitations are moderate. Competing vegetation can be controlled by proper site preparation, by prescribed burning, or by spraying, cutting, or girdling. Seedling mortality and the hazards or limitations that affect planting or harvesting are slight.

The capability subclass is IIw.

809B—Bertram fine sandy loam, 2 to 6 percent slopes. This gently sloping and moderately sloping, somewhat excessively drained soil is on ridges and side slopes in the uplands. Areas are irregularly shaped and range from 2 to 10 acres in size.

Typically, the surface layer is very dark brown fine sandy loam about 7 inches thick. The subsurface layer is very dark brown and very dark grayish brown fine sandy loam about 11 inches thick. The subsoil is about 21 inches thick. The upper part is brown, very friable fine sandy loam and sandy loam, and the lower part is very dark grayish brown, friable sandy clay loam. Fractured limestone bedrock is at a depth of about 39 inches. Some tongues of mottled grayish brown and yellowish brown residuum are between the limestone fragments.

Permeability is moderately rapid. Available water capacity is low. Surface runoff is medium. The surface layer is very friable and can be easily tilled throughout a fairly wide range of moisture content, but it tends to crust after hard rains or puddle if tilled when wet. The organic matter content is about 1 to 2 percent in the surface layer. The shrink-swell potential is low in the upper part of the soil and moderate in the lower part. The root zone extends only to the limestone bedrock. Reaction varies widely in the surface layer as a result of local liming practices. The subsoil is medium acid. It has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is poorly suited to corn and soybeans. It is better suited to small grain and to grasses or legumes for hay and pasture. Droughtiness is a limitation in most years unless rainfall is timely. Yields are affected by the amount and timeliness of rainfall. If cultivated crops are grown, water erosion and wind erosion are hazards. Blowing sand grains sometimes damage newly seeded crops on this soil and on the adjoining soils unless the surface is protected by a plant cover. A conservation tillage system that leaves crop residue on the surface and cover crops help to prevent excessive soil loss. The soil warms up quickly in the spring, thus stimulating early plant growth. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing and grazing when the soil is too wet or too dry, however, reduce the extent of the protective plant cover and cause deterioration of the plant community. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet or dry periods help to keep the pasture and the soil in good condition.

The capability subclass is IVs.

813—Atkinson loam, 0 to 2 percent slopes. This nearly level, well drained soil is on uplands. Areas are irregularly shaped and range from 2 to more than 100 acres in size.

Typically, the surface layer is very dark brown loam about 6 inches thick. The subsurface layer is very dark brown and dark brown loam about 14 inches thick. The subsoil is about 23 inches of yellowish brown loam. The upper part is friable, and the lower part is firm. Fractured limestone bedrock is at a depth of about 43 inches.

Included with this soil in mapping are small areas of soils that have a loamy sand or sand surface layer. These soils are lower in organic matter content than the Atkinson soil and have a lower available water capacity. They are in similar positions on the landscape. They make up about 5 percent of the unit.

Permeability is moderate in the Atkinson soil. Available water capacity also is moderate. Surface runoff is slow or medium. The surface layer is friable and can be easily tilled when wet. The organic matter content is about 3 to 4 percent in the surface layer. The shrink-swell potential is low throughout the soil. The root zone extends only to the bedrock. Reaction varies widely in the surface layer as a result of local liming practices. The subsoil is medium acid or slightly acid. It has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to intensive cropping of corn and soybeans, to small grain, and to grasses or legumes for hay and pasture. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

Some areas are used for pasture or hay. Overgrazing or grazing when the soil is too wet causes surface compaction and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability class is I.

883B—Cresco loam, 2 to 5 percent slopes. This gently sloping, moderately well drained soil is on long, convex ridgetops and side slopes in the uplands. Areas are irregularly shaped or are elliptical and range from 20 to more than 100 acres in size.

Typically, the surface layer is black loam about 6 inches thick. The subsurface layer is very dark gray and very dark grayish brown loam about 10 inches thick. The subsoil is about 41 inches thick. The upper part is brown, friable loam and yellowish brown, firm loam; the next part is yellowish brown, very firm clay loam that has nearly continuous grayish brown coatings; and the lower part is mottled strong brown and yellowish brown, very firm clay loam that has thick or thin, nearly continuous or discontinuous coatings. The substratum to a depth of about 60 inches is mottled strong brown and yellowish brown clay loam.

Included with this soil in mapping are small areas of Kenyon soils on the slightly lower, truncated ridgetops. These soils contain less clay in the lower part of the subsoil than the Cresco soil. They make up less than 5 percent of the unit.

The Cresco soil is moderately permeable in the upper part and moderately slowly permeable in the lower part. It has a seasonal high water table. Available water capacity is high. Surface runoff is medium. The surface layer is friable and can be easily tilled but tends to crust after hard rains and puddle if tilled when wet. The organic matter content is about 3 to 4 percent in the surface layer. The shrink-swell potential is moderate throughout the soil. Reaction varies widely in the surface layer as a result of local liming practices. The subsoil is medium acid to neutral. It has a very low supply of available phosphorus and potassium.

Most areas are cultivated. This soil is well suited to intensive cropping of corn and soybeans, to small grain, and to grasses or legumes for hay and pasture. If cultivated crops are grown, erosion is a hazard. A conservation tillage system that leaves a protective amount of crop residue on the surface throughout the year and terraces help to prevent excessive soil loss. If terraces are built, cuts should not expose the less productive underlying glacial till. Returning crop residue to the soil or regularly adding other organic material improves fertility, helps to prevent surface crusting, and increases the rate of water infiltration.

A cover of pasture plants or hay is effective in controlling erosion. Overgrazing or grazing when the soil is too wet, however, causes surface compaction, excessive runoff, and poor tilth. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture and the soil in good condition.

The capability subclass is IIe.

1585—Spillville-Coland complex, channeled, 0 to 2 percent slopes. These nearly level, somewhat poorly drained and poorly drained soils are on flood plains along the larger streams and their tributaries. They are frequently flooded. They generally are cut by many stream channels. As a result, escarpments are common on the higher alluvial benches. Oxbows and marshy areas are below most of the escarpments. Areas are long and narrow or are wide and irregularly shaped and are several thousand acres in size. They are about 50 percent Spillville soil and 36 percent Coland soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Spillville soil has a surface layer of black loam about 9 inches thick. The subsurface layer is black and very dark brown loam about 31 inches thick. The upper part of the substratum is brown sandy loam mottled with dark grayish brown. The lower part to a depth of about 60 inches is yellowish brown loamy sand mottled with grayish brown and brown.

Typically, the Coland soil has a surface layer of black clay loam about 9 inches thick. The subsurface layer is

black and very dark gray clay loam about 39 inches thick. The substratum to a depth of about 60 inches is dark gray clay loam mottled with brown.

Included with these soils in mapping are areas of highly stratified, recently deposited alluvial sediments that have not been in place long enough for a soil profile to form. The sediments typically are sandy loam or loamy sand. The organic matter content, permeability, available water capacity, and shrink-swell potential vary. Reaction generally is neutral or slightly acid. Included areas make up about 14 percent of the unit.

The Spillville and Coland soils are moderately permeable. They have a seasonal high water table. Available water capacity is high. Surface runoff is slow. The surface layer is friable. The organic matter content is about 4 to 6 percent in the surface layer of the Spillville soil and about 5 to 7 percent in the Coland soil. The shrink-swell potential is moderate in the upper part of the Spillville soil and high in the Coland soil. Both soils are neutral or slightly acid throughout. Their subsurface layer has a low supply of available phosphorus and a very low supply of available potassium.

These soils generally are unsuited to cultivation unless they are protected by levees. Land leveling and a surface drainage system are needed in some areas before oxbows and sloughs can be crossed by farm equipment.

Some areas have been cleared and are used for permanent pasture; other areas support bushes and scrubby trees. These soils are well suited to woodland and wetland wildlife habitat (fig. 14). Unless major reclamation measures are applied, they are best suited to pasture, woodland, or wildlife habitat.

The capability subclass is Vw.

5010—Pits, sand and gravel. This map unit consists of borrow pits, gravel pits, and sand pits on alluvial benches and uplands. About 5 to 20 feet of coarse textured material has been removed from the pits and used primarily for roads, driveways, and construction. Some areas have been reshaped, but most have vertical sides that support little or no vegetation. The bottom of the pits generally supports some vegetation.

Most of the pits are no longer used as a source of sand and gravel. They are well suited to wildlife habitat. The ponds produced by dredging could support fish. Because of the steepness of the sides and the variable depth of the water, however, they could be dangerous as sites for recreation and wildlife habitat.

One area, northwest of Independence, is still being dredged. It is a pit that is several acres in size, contains water many feet deep, and has steep sides.

No capability class or subclass is assigned.

5030—Pits, limestone quarries. This map unit consists of pits from which limestone has been quarried, primarily for use in road construction and as agricultural lime. The pits are 40 feet or more deep and are surrounded by piles of spoil 15 feet or more high. They are irregularly shaped and range from a few acres to 40 acres in size. Some contain water a few to many feet deep and have steep sides.

The spoil surrounding the pits varies in texture but generally is loamy and contains varying amounts of limestone fragments. It is derived from glacial till, eolian material, or a mixture of the two. In some areas it has been leveled and smoothed, but in other areas it is very uneven. In the level areas grasses or trees grow reasonably well. The spoil ranges from medium acid to mildly alkaline.

The quarries are well suited to wildlife habitat. Those containing water could support fish. Because of the steepness of the sides and the variable depth of the water, however, they could be dangerous as sites for recreation and wildlife habitat. Onsite investigation is needed to determine the hazard.

No capability class or subclass is assigned.

5040—Orthents, loamy. These nearly level to strongly sloping soils are used as borrow areas for construction. In some areas the original soil has been removed to a depth of 5 to 20 feet or more, and in other areas 4 to 10 inches of topsoil has been redistributed, commonly in an uneven pattern. The soils range from excessively drained to somewhat poorly drained, depending on the kind of material from which the soils were derived and the extent to which the borrow area is restored. Areas typically range from 6 to 50 acres in size.

Typically, the upper 60 inches is yellowish brown, friable and firm loam. In many areas cobbles and pebbles are common on the surface. In some areas the texture is sandy loam. The surface color ranges from very dark gray to dark brown.

Included with these soils in mapping are small areas of sand. Also included are a few areas that were once dumps or landfills and have now been covered.

Permeability varies in the Orthents, depending on the texture and density. Available water capacity is moderate or low. Soil that was once buried 5 to 20 feet or more beneath the surface has less pore space and a higher density than the original surface layer. It has not been appreciably affected by the processes of soil formation, such as freezing and thawing. Surface runoff is slow to rapid. The content of organic matter is very low unless the topsoil has been redistributed throughout the area. As a result, preparing a good seedbed is difficult and drought is a hazard. Reaction typically is moderately alkaline. In most areas these soils have a very low supply of available phosphorus and potassium.

These soils are better suited to small grain and to grasses and legumes for hay and pasture than to row crops. They are suited to row crops only in some areas

Figure 14.—An area of Spillville-Coland complex, channeled, 0 to 2 percent slopes, used for wildlife habitat.

where the topsoil has been redistributed. Corn and soybeans are grown in these areas. If cultivated crops are grown, erosion is a moderate or severe hazard in the more sloping areas. A conservation tillage system that turns over as little soil as possible and leaves crop residue on the surface helps to control erosion and stabilize the soils.

No capability class or subclass is assigned.

prime farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in providing the Nation's short- and long-range needs for food and fiber. Because the supply of high quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cropland, pasture, woodland, or other land, but it is not urban or built-up land or water areas. It either is used for food or fiber or is available for these uses. The soil qualities, growing season, and moisture supply are those needed for a well managed soil economically to produce a

sustained high yield of crops. Prime farmland produces the highest yields with minimal inputs of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland usually has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at local offices of the Soil Conservation Service.

About 290,000 acres throughout Buchanan County, or nearly 80 percent of the total acreage, meets the requirements for prime farmland. Crops are grown on about 280,000 acres of the prime farmland. They account for an estimated two-thirds of the local agricultural income each year. They are mainly corn and soybeans.

Parts of the county recently have been losing some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and difficult to cultivate and are less productive.

The map units that meet the requirements for prime farmland in Buchanan County are listed in this section. Some of the map units meet the requirements for prime farmland only in areas where the soil is drained. Onsite investigation is needed to determine whether or not a specific area of the soil is adequately drained. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps in the back of this publication. The soil qualities that affect use and management are described in the section "Detailed soil map units." The map units that are considered prime farmland are:

813—Atkinson loam, 0 to 2 percent slopes
171B—Bassett loam, 2 to 5 percent slopes
84—Clyde clay loam, 0 to 3 percent slopes (where drained)
391B—Clyde-Floyd complex, 1 to 4 percent slopes (where drained)
883B—Cresco loam, 2 to 5 percent slopes
290—Dells silt loam, 0 to 2 percent slopes
175—Dickinson fine sandy loam, 0 to 2 percent slopes
175B—Dickinson fine sandy loam, 2 to 5 percent slopes
377B—Dinsdale silt loam, 2 to 5 percent slopes
782B—Donnan loam, 2 to 6 percent slopes
198B—Floyd loam, 1 to 4 percent slopes
761—Franklin silt loam, 1 to 3 percent slopes (where drained)
725—Hayfield loam, 24 to 32 inches to sand and gravel, 0 to 2 percent slopes
83B—Kenyon loam, 2 to 5 percent slopes
184—Klinger silty clay loam, 1 to 3 percent slopes
110—Lamont fine sandy loam, 0 to 2 percent slopes
110B—Lamont fine sandy loam, 2 to 5 percent slopes
225—Lawler loam, 24 to 32 inches to sand and gravel, 0 to 2 percent slopes
226—Lawler loam, 32 to 40 inches to sand and gravel, 0 to 2 percent slopes
151—Marshan clay loam, 24 to 32 inches to sand and gravel, 0 to 2 percent slopes (where drained)
152—Marshan clay loam, 32 to 40 inches to sand and gravel, 0 to 2 percent slopes (where drained)
382—Maxfield silty clay loam, 0 to 2 percent slopes (where drained)
408B—Olin fine sandy loam, 2 to 5 percent slopes
471—Oran loam, 1 to 3 percent slopes (where drained)
798B—Protivin loam, 1 to 4 percent slopes
399—Readlyn loam, 1 to 3 percent slopes
213B—Rockton loam, 30 to 40 inches to limestone, 2 to 6 percent slopes
214—Rockton loam, 20 to 30 inches to limestone, 0 to 2 percent slopes
177—Saude loam, 0 to 2 percent slopes
177B—Saude loam, 2 to 5 percent slopes
407B—Schley loam, 1 to 4 percent slopes (where drained)
807B—Schley Variant sandy loam, 1 to 4 percent slopes (where drained)
663B—Seaton silt loam, 2 to 5 percent slopes
485—Spillville loam, 0 to 2 percent slopes
585—Spillville-Coland complex, 0 to 2 percent slopes (where drained)
398—Tripoli clay loam, 0 to 2 percent slopes (where drained)
777—Wapsie loam, 0 to 2 percent slopes
178—Waukee loam, 0 to 2 percent slopes
205B—Whalan silt loam, 30 to 40 inches to limestone, 2 to 5 percent slopes
207B—Whalan silt loam, 20 to 30 inches to limestone, 2 to 5 percent slopes

use and management of the soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

crops and pasture

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed soil map units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

About 273,000 acres in Buchanan County was used for crops and hay in 1974. Of this total, about 26,000 acres was used for hay. An additional 42,000 acres was pastured.

The acreage used for crops and pasture has gradually been decreasing as more land is used for urban development and other purposes, such as parks and recreation areas. In 1967, an estimated 13,472 acres was urban and built-up land. The acreage of this land is growing at the rate of less than 100 acres per year.

The paragraphs that follow describe the hazards and limitations affecting the use of the soils in the county for crops and pasture.

Soil erosion is the major problem on more than 40 percent of the cropland and pasture in Buchanan County. If the slope is more than 2 percent, erosion is a hazard on Bassett, Cresco, Kenyon, Olin, and other soils.

Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into a plow layer. Loss of the surface layer is especially damaging on soils with a clayey subsoil, such as Donnan soils; on soils that tend to be droughty, such as the more sloping Dickinson and Lilah soils; and on soils having a layer that restricts the root zone in or below the subsoil. An example of this kind of layer is the bedrock in Backbone, Bertram, Rockton, Sogn, and Whalan soils. Second, erosion can result in pollution of streams by sediment. Control of erosion improves the quality of water for municipal use, for recreation, and for fish and wildlife by minimizing the pollution of streams.

In some sloping fields, preparing a good seedbed and tilling are difficult on clayey spots because the original friable surface soil has been eroded away. Such spots are common in areas of Donnan soils.

Erosion control provides a protective plant cover, reduces the runoff rate, and increases the available water capacity and infiltration rate. A cropping system that keeps a plant cover on the surface for extended periods can hold soil losses to an amount that will not

reduce the productive capacity of the soils. On livestock farms, where part of the acreage is pasture and hayland, including legumes and grasses in the cropping system not only provides nitrogen and improves tilth for the following crop but also reduces the risk of erosion on the more sloping soils.

Terracing is not practical in areas of the more sloping Finchford and Lilah soils because slopes are too short and irregular and textures are moderately coarse and coarse. On these soils a cropping system that provides a protective plant cover and measures that divert concentrated runoff from slopes at the higher elevations are needed. A conservation tillage system that leaves crop residue on the surface increases the rate of water infiltration and the available water capacity and reduces the risks of runoff and erosion. It can be effective on most of the soils in the county. No-tillage helps to control erosion in the more sloping areas that are used for corn.

Terraces and diversions reduce the length of slopes and the hazards of runoff and erosion. They are most practical on deep, well drained soils that have regular slopes. Bassett, Cresco, Dinsdale, and Kenyon soils and some areas of the Seaton soils are suitable for terracing. Other soils are less suitable for terraces and diversions because of slopes that are too irregular or too steep, because of excessive wetness in terrace channels, or because of bedrock within a depth of 40 inches. Unless tile inlet terraces are used in the excessively wet areas, a clayey subsoil would be exposed in the terrace channels.

Contour farming and stripcropping are effective in controlling erosion in the survey area. They are most effective on soils with smooth, uniform slopes, including most areas of the more sloping Bassett, Cresco, Dinsdale, Kenyon, and Readlyn soils.

Wind erosion is a hazard on the sandy Chelsea, Dickinson, Finchford, Olin, and Sparta soils and on the organic Palms soils. It can damage these soils in a few hours if winds are strong and the soils are dry and have no plant cover or surface mulch. Maintaining a plant cover or surface mulch and keeping the surface rough through proper tillage minimize the damage caused by wind erosion on all of these soils. Windbreaks of suitable shrubs, such as Tatarian honeysuckle or autumn-olive, are effective in controlling wind erosion on the organic soils.

Information about the design of erosion-control practices for each kind of soil is contained in the Technical Guide, available in local offices of the Soil Conservation Service.

Soil drainage is the major management concern on about one-third of the acreage used for crops and pasture in Buchanan County. Some soils are naturally so wet that the production of crops generally is not possible unless a drainage system is installed. Examples are the somewhat poorly drained Floyd and Schley soils and the poorly drained Clyde, Marshan, and Tripoli soils, which make up about 77,000 acres in the county.

The design of both surface and subsurface drainage systems varies with the kind of soil. A combination of surface drains or a system that controls the runoff from the slopes at the higher elevations and drainage tile is needed in most areas of the somewhat poorly drained and poorly drained soils that are intensively row cropped. Drains should be more closely spaced in moderately slowly permeable soils than in the more rapidly permeable soils. Finding adequate outlets for tile drainage systems is difficult in many areas of the Marshan and Spillville soils.

Organic soils oxidize and subside when the pore space is filled with air. As a result, special drainage systems are needed to control the depth and the period of drainage. Keeping the water table at the level required by crops during the growing season and raising it to the surface during other parts of the year minimize the oxidation and subsidence of organic soils. Information about the design of drainage systems for each kind of soil is contained in the Technical Guide, available in local offices of the Soil Conservation Service.

Soil fertility, as determined by the supply of available phosphorus and potassium in the subsoil, is low or very low in most soils on uplands. The Seaton soils, however, have a high supply of available phosphorus in the subsoil. Most medium textured, well drained and somewhat poorly drained upland soils that have a slope of less than 5 percent formed under grasses. The content of organic matter is 3 to 6 percent in these soils. It is less than 1 percent to 2 percent in most coarse and moderately coarse textured soils on uplands. It is 1 to 3 percent in most medium textured soils that formed under grasses and trees. It is more than 20 percent in the very poorly drained, organic Palms soils and 6 to 10 percent in the poorly drained upland soils, such as Clyde, Maxfield, and Tripoli soils. Reaction is neutral in the Clyde, Maxfield, and Tripoli soils, but most of the other upland soils are acid in the subsoil. Applications of ground limestone are needed to raise the pH level sufficiently for alfalfa and other crops to grow well on the acid soils.

Alluvial soils in the county have a low or very low supply of available phosphorus and potassium in the subsoil. The content of organic matter is 5 to 6 percent in most of the well drained and somewhat poorly drained, medium textured soils that formed in alluvium and 5 to 6 percent in the poorly drained Marshan soils, which also formed in alluvium. Reaction is slightly acid or medium acid in the medium textured soils and neutral in the Marshan soils.

Applications of lime and fertilizer should be based on the results of soil tests, on the need of the intended crop, and on the expected level of yields. The Cooperative Extension Service can help in determining the kinds and amounts of fertilizer and lime needed.

Soil tilth is an important factor in the germination of seeds and in the infiltration of water into the soil. Soils with good tilth are granular and porous.

Unless eroded, most of the soils used for crops have a loam surface layer that is darker and higher in organic matter content than the surface layer of timbered soils. Generally, the structure of the surface layer is weak. As a result, intense rainfall causes the formation of a crust on the surface. The crust is hard when dry and nearly impervious to water. It reduces the infiltration rate and increases the runoff rate. Regularly adding crop residue, manure, and other organic material improves the soil structure and helps to prevent crusting.

Fall plowing is not desirable on most of the soils in the county. It increases the susceptibility to erosion unless the surface is protected.

yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that insures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils.

land capability classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for woodland and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have slight limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, woodland, wildlife habitat, or recreation.

Capability units are soil groups within a subclass. The soils in a capability unit are enough alike to be suited to

the same crops and pasture plants, to require similar management, and to have similar productivity.

The acreage of soils in each capability class and subclass is shown in table 6. The capability classification of each map unit is given in the section "Detailed soil map units."

woodland management and productivity

Table 7 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination (woodland suitability) symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for important trees. The number 1 indicates very high productivity; 2, high; 3, moderately high; 4, moderate; and 5, low. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *x* indicates stoniness or rockiness; *w*, excessive water in or on the soil; *t*, toxic substances in the soil; *d*, restricted root depth; *c*, clay in the upper part of the soil; *s*, sandy texture; *f*, high content of coarse fragments in the soil profile; and *r*, steep slopes. The letter *o* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: x, w, t, d, c, s, f, and r.

In table 7, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Ratings of the *erosion hazard* indicate the risk of loss of soil in well managed woodland. The risk is *slight* if the expected soil loss is small, *moderate* if measures are needed to control erosion during logging and road construction, and *severe* if intensive management or special equipment and methods are needed to prevent excessive loss of soil.

Ratings of *equipment limitation* reflect the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. A rating of *slight* indicates that use of equipment is not limited to a particular kind of equipment or time of year; *moderate* indicates a short seasonal limitation or a need for some modification in management or in equipment; and *severe* indicates a seasonal limitation, a need for special equipment or management, or a hazard in the use of equipment.

Seedling mortality ratings indicate the degree to which the soil affects the mortality of tree seedlings. Plant competition is not considered in the ratings. The ratings apply to seedlings from good stock that are properly planted during a period of sufficient rainfall. A rating of *slight* indicates that the expected mortality is less than 25 percent; *moderate*, 25 to 50 percent; and *severe*, more than 50 percent.

Ratings of *windthrow hazard* are based on the soil characteristics that affect the development of tree roots and the ability of the soil to hold trees firmly. A rating of *slight* indicates that a few trees may be blown down by normal winds; *moderate*, that some trees will be blown down during periods of excessive soil wetness and strong winds; and *severe*, that many trees are blown down during periods of excessive soil wetness and moderate or strong winds.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index*. This index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

Trees to plant are those that are suited to the soils and to commercial wood production.

windbreaks and environmental plantings

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, keep snow from blowing off the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 8 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 8 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a nursery.

recreation

The soils of the survey area are rated in table 9 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 9 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 12 and interpretations for dwellings without basements and for local roads and streets in table 11.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking, horseback riding, and bicycling should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required. The best soils for use as golf fairways are firm when wet, are not dusty when dry, and are not subject to prolonged flooding during the period of use. They have moderate slopes and no stones or boulders on the surface. The suitability of the soil for tees or greens is not considered in rating the soils.

wildlife habitat

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 10, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, orchardgrass, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, wheatgrass, and grama.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, the available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, apple, hawthorn, dogwood, hickory, blackberry, and elderberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, autumn-olive, and crabapple.

Coniferous plants furnish browse, seeds, and cones. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite, pheasant, meadowlark, field sparrow, cottontail, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, and deer.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure

aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

building site development

Table 11 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, depth to bedrock or to a cemented pan, the available water capacity in the upper 40 inches, and the content of salts, sodium, and sulfidic materials affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

sanitary facilities

Table 12 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 12 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that

soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 12 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to wind erosion.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

construction materials

Table 13 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material (fig. 15). Normal compaction, minor processing, and other

standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers

Figure 15.—An area of Finchford loamy sand, 0 to 2 percent slopes, used as a source of sand. Because the deposits of sand are within the water table of nearby streams, dredging is possible.

of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 13, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel or stones, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

water management

Table 14 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders or organic matter. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan,

large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as a high content of calcium carbonate. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, restricted rooting depth, toxic substances, such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

soil properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

engineering index properties

Table 15 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil series and their morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as 15 or 20 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as Pt. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The

estimates are based on test data from the survey area or from nearby areas and on field examination.

physical and chemical properties

Table 16 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at 1/3 bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops.

They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to wind erosion.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 16, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

soil and water features

Table 17 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams and by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes are not considered flooding.

Table 17 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered is local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 17.

An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An artesian water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A perched water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations generally can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavations.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low, moderate,* or *high,* is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*13*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table 18, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Aquoll (*Aqu*, meaning water, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haplaquolls (*Hapl*, meaning minimal horizonation, plus *aquoll*, the suborder of the Mollisols that have an aquic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Haplaquolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed, mesic Typic Haplaquolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

soil series and their morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual* (*12*). Many of the technical terms used in the descriptions are defined in *Soil Taxonomy* (*13*). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed soil map units."

Atkinson series

The Atkinson series consists of well drained, moderately permeable soils on the crest of ridges in the uplands. These soils formed in about 14 to 26 inches of loamy sediments and in glacial till over limestone bedrock. The native vegetation was prairie grasses. Slope ranges from 0 to 2 percent.

Atkinson soils commonly are adjacent to Rockton soils. They are deeper to limestone bedrock than those soils. Their position on the landscape is similar to that of the Rockton soils.

Typical pedon of Atkinson loam, 0 to 2 percent slopes, 1,420 feet south and 429 feet west of the center of sec. 2, T. 90 N., R. 10 W.

Ap—0 to 6 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; friable; medium acid; abrupt smooth boundary.

A12—6 to 16 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; friable; slightly acid; clear smooth boundary.

A3—16 to 20 inches; dark brown (10YR 3/3) loam, brown (10YR 4/3) dry; weak fine subangular blocky structure; friable; nearly continuous very dark grayish brown (10YR 3/2) coatings on faces of peds; slightly acid; clear smooth boundary.

B1—20 to 25 inches; yellowish brown (10YR 5/4) loam; weak medium and fine subangular blocky structure; friable; distinct continuous coatings on faces of peds; medium acid; clear smooth boundary.

IIB21t—25 to 36 inches; yellowish brown (10YR 5/6) loam; moderate medium and fine subangular blocky structure; firm; few fine distinct strong brown (7.5YR 5/8) and dark brown (7.5YR 4/4) mottles; few discontinuous clay films and brown (10YR 5/3) coatings on faces of peds; discontinuous stone line at 25 inches; medium acid; gradual smooth boundary.

IIB22t—36 to 43 inches; yellowish brown (10YR 5/6) loam; moderate medium subangular and angular blocky structure; firm; nearly continuous brown (10YR 5/3) coatings and discontinuous clay films on faces of peds; neutral; abrupt wavy boundary.

IIIR—43 inches; fractured limestone bedrock; brownish yellow (10YR 6/6) very fine sandy loam between rock fragments; slight effervescence; mildly alkaline.

The solum typically is 40 to 45 inches thick but in some pedons ranges to about 55 inches thick. It typically is loam, but in some pedons the lower part of the B horizon is clay loam or sandy clay loam.

The A horizon ranges from 10 to 24 inches in thickness. The A1 horizon is black (10YR 2/1) or very dark brown (10YR 2/2). The A3 horizon is very dark brown (10YR 2/2), very dark grayish brown (10YR 3/2), or dark brown (10YR 3/3). The B2 horizon has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 3 to 8. The upper part of the limestone bedrock is decomposed or fractured in most pedons.

Backbone series

The Backbone series consists of well drained soils on convex ridges and side slopes in the uplands. These soils formed in 20 to 40 inches of moderately coarse textured eolian material and, in most places, loamy or clayey material weathered from limestone. Permeability is moderately rapid. The native vegetation was prairie grasses and trees. Slope ranges from 2 to 6 percent.

Backbone soils commonly are adjacent to Chelsea and Lamont soils. The adjacent soils are not underlain by limestone bedrock within a depth of 60 inches. Their position on the landscape is similar to that of the Backbone soils.

Typical pedon of Backbone fine sandy loam, 2 to 6 percent slopes, 2,475 feet east and 960 feet south of the northwest corner of sec. 27, T. 88 N., R. 8 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) fine sandy loam, grayish brown (10YR 5/2) dry; some dark yellowish brown (10YR 4/4) streaks; weak fine subangular blocky structure; very friable; neutral; abrupt smooth boundary.

B1t—8 to 17 inches; brown (7.5YR 4/4) sandy loam; weak medium and fine subangular blocky structure; very friable; thin discontinuous very dark grayish brown (10YR 3/2) coatings and few thin discontinuous clay films on faces of peds; some clay bridging between sand grains; neutral; clear smooth boundary.

B21t—17 to 25 inches; brown (7.5YR 4/4) sandy loam; common fine faint dark brown (7.5YR 3/2) mottles; moderate medium subangular blocky structure; very friable; thin discontinuous clay films on faces of peds; some clay bridging between sand grains; neutral; clear smooth boundary.

B22t—25 to 32 inches; brown (7.5YR 4/4) sandy loam; few fine faint strong brown (7.5YR 5/6) mottles; weak coarse prismatic structure parting to weak medium and fine subangular blocky; very friable; some clay bridging between sand grains; neutral; abrupt smooth boundary.

IIB23t—32 to 35 inches; dark reddish gray (5YR 4/2) clay loam; strong medium and fine angular blocky structure; very firm; discontinuous clay films on faces of peds; neutral; abrupt wavy boundary.

IIR—35 inches; fractured limestone bedrock; some clay rinds on the upper flagstones.

The solum ranges from 20 to 40 inches in thickness. It ranges from neutral to strongly acid.

The A1 or Ap horizon commonly is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2) when moist and gray (10YR 5/1) or grayish brown (10YR 5/2) when dry. An A2 horizon is evident in some uneroded areas. It is about 2 to 4 inches thick and is dark grayish brown (10YR 4/2) or brown (10YR 5/3). The IIB23t horizon formed either in residuum of limestone or in the B horizon of a paleosol. It ranges from clay loam to clay.

Bassett series

The Bassett series consists of moderately well drained, moderately permeable soils on convex ridges and side slopes in the uplands. These soils formed in

about 14 to 26 inches of loamy sediments and in the underlying glacial till. The native vegetation was prairie grasses and trees. Slope ranges from 2 to 9 percent.

Bassett soils are similar to Kenyon soils and commonly are adjacent to Clyde, Floyd, and Kenyon soils. Kenyon soils are in positions on the landscape similar to those of the Bassett soils. Their A horizon is thicker and darker than that of the Bassett soils. The poorly drained Clyde and somewhat poorly drained Floyd soils are along drainageways and are lower on the landscape than the Bassett soils. Also, their subsoil is grayer.

Typical pedon of Bassett loam, 2 to 5 percent slopes, 990 feet south and 30 feet east of the center of sec. 16, T. 90 N., R. 9 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; slightly acid; abrupt smooth boundary.

A2—6 to 9 inches; very dark grayish brown (10YR 3/2) loam, light brownish gray (10YR 6/2) dry; some yellowish brown (10YR 5/4) streaks; weak thin platy structure parting to weak fine granular; friable; slightly acid; clear smooth boundary.

B1—9 to 14 inches; yellowish brown (10YR 5/4) loam; few fine distinct yellowish brown (10YR 5/6) mottles; weak fine granular structure; friable; slightly acid; clear smooth boundary.

IIB21t—14 to 20 inches; yellowish brown (10YR 5/4) loam; common fine distinct strong brown (7.5YR 5/6) mottles; moderate fine subangular blocky structure; friable; stone line at 14 inches; few thin discontinuous clay films on faces of peds; strongly acid; gradual smooth boundary.

IIB22—20 to 28 inches; strong brown (7.5YR 5/6) loam; common fine distinct light brownish gray (10YR 6/2) mottles; moderate medium angular blocky structure; friable; discontinuous brown (10YR 5/3) coatings on faces of peds; thick discontinuous light gray (10YR 7/2) silt and sand coatings on faces of peds when dry; strongly acid; gradual smooth boundary.

IIB31t—28 to 36 inches; mottled strong brown (7.5YR 5/6) and light brownish gray (10YR 6/2) loam; moderate coarse prismatic structure parting to moderate medium subangular and angular blocky; firm; few dark oxides; few discontinuous dark grayish brown (10YR 4/2) clay films on faces of prisms; few dark grayish brown (10YR 4/2) clay filled root channels; few discontinuous light gray (10YR 7/2) sand and silt coatings on faces of prisms when dry; strongly acid; gradual smooth boundary.

IIB32t—36 to 55 inches; mottled strong brown (7.5YR 5/6) and grayish brown (10YR 5/2) loam; moderate coarse prismatic structure parting to moderate medium and fine subangular blocky; firm; common dark oxides; common dark grayish brown (10YR 4/2) clay filled root channels; slightly acid; abrupt smooth boundary.

IIC—55 to 60 inches; mottled strong brown (7.5YR 5/6) and grayish brown (10YR 5/2) loam; massive; firm; common fine lime concretions; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 40 to 60 inches. In uncultivated areas the A1 horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). It is 6 to 9 inches thick. In cultivated areas the Ap horizon is very dark grayish brown (10YR 3/2) or brown (10YR 4/3). It is about 6 to 8 inches thick. The A2 horizon commonly is very dark grayish brown (10YR 3/2) or dark grayish brown (10YR 4/2). It is 2 to 8 inches thick.

The B and IIB horizons are dominantly loam or clay loam, but the range includes sandy clay loam. The B horizon has hue of 10YR, value of 4 or 5, and chroma of 3 or more. In some pedons a stone line does not separate the B horizon from the IIB horizon. In uneroded areas the depth to the IIB horizon ranges from 14 to 26 inches. This horizon is slightly acid to strongly acid. It has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 or more and has lower chroma mottles.

Bertram series

The Bertram series consists of somewhat excessively drained soils on convex ridges and side slopes in the uplands. These soils formed in 20 to 40 inches of eolian sandy loam and in a thin, discontinuous layer of limestone residuum over limestone bedrock. Permeability is moderately rapid. The native vegetation was prairie grasses. Slope ranges from 2 to 6 percent.

Bertram soils are similar to Backbone soils and commonly are adjacent to Dickinson and Rockton soils. They are in positions on the landscape similar to those of the adjacent soils. The A horizon of Backbone soils is thinner and lighter colored than that of the Bertram soils. Dickinson soils are not underlain by limestone bedrock within a depth of 40 inches. Rockton soils contain less sand in the B horizon than the Bertram soils.

Typical pedon of Bertram fine sandy loam, 2 to 6 percent slopes, 890 feet north and 860 feet east of the southwest corner of sec. 33, T. 87 N., R. 10 W.

Ap—0 to 7 inches; very dark brown (10YR 2/2) fine sandy loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; very friable; neutral; abrupt smooth boundary.

A12—7 to 12 inches; very dark brown (10YR 2/2) fine sandy loam, very dark grayish brown (10YR 3/2) dry; weak fine subangular blocky structure; very friable; neutral; clear smooth boundary.

A3—12 to 18 inches; very dark grayish brown (10YR 3/2) fine sandy loam, brown (10YR 5/3) dry; some brown (10YR 4/3) streaks; weak fine subangular

blocky structure; very friable; neutral; clear smooth boundary.

B1—18 to 26 inches; brown (10YR 4/3) fine sandy loam; weak fine subangular blocky structure; very friable; nearly continuous very dark grayish brown (10YR 3/2) coatings on faces of peds; medium acid; clear smooth boundary.

B2t—26 to 36 inches; brown (10YR 4/3) sandy loam; moderate medium and fine subangular blocky structure; very friable; some clay bridging between sand grains along root channels; medium acid; clear smooth boundary.

IIB3t—36 to 39 inches; very dark grayish brown (10YR 3/2) sandy clay loam; common fine distinct yellowish brown (10YR 5/4) and brown (7.5YR 4/4) mottles; moderate medium and fine subangular blocky structure; friable; some clay bridging between sand grains; medium acid; abrupt wavy boundary.

IIR—39 inches; fractured hard limestone bedrock; tongues of mottled grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/6) residuum between flagstones; thin discontinuous strata of yellowish brown (10YR 5/4) weathered limestone at 39 to 40 inches.

The thickness of the solum ranges from 20 to 40 inches. The thickness of the A horizon ranges from 14 to 24 inches. The Ap and A1 horizons are very dark brown (10YR 2/2) or very dark grayish brown (10YR 3/2). The B2 horizon dominantly has hue of 10YR, value of 3 to 5, and chroma of 3 or 4. It typically is sandy loam, but the range includes sandy clay loam. The IIB horizon is 2 to 6 inches thick and is sandy clay loam or clay loam. Some pedons do not have a IIB horizon.

Burkhardt series

The Burkhardt series consists of somewhat excessively drained soils on uplands. These soils formed in moderately coarse textured material about 12 to 24 inches deep over sand and gravel. Permeability is moderately rapid in the upper part and rapid in the lower part. The native vegetation was prairie grasses. Slope ranges from 2 to 5 percent.

Burkhardt soils are similar to Lilah soils and commonly are adjacent to Saude soils. The solum of Lilah soils is thicker than that of the Burkhardt soils. Saude soils are in positions on the landscape similar to those of the Burkhardt soils. Their A horizon is finer textured than that of the Burkhardt soils.

Typical pedon of Burkhardt sandy loam, in an area of Burkhardt-Saude complex, 2 to 5 percent slopes, 726 feet south and 1,056 feet east of the center of sec. 23, T. 90 N., R. 7 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) sandy loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; very friable; slightly acid; abrupt smooth boundary.

A3—7 to 13 inches; dark brown (10YR 3/3) sandy loam, brown (10YR 4/3) dry; weak medium subangular blocky structure; very friable; slightly acid; clear smooth boundary.

B2t—13 to 18 inches; brown (10YR 4/3) sandy loam; discontinuous dark brown (10YR 3/3) coatings on faces of peds; weak medium subangular blocky structure; some clay bridging between sand grains; very friable; medium acid; clear smooth boundary.

IIC1—18 to 35 inches; brown (7.5YR 4/4) and strong brown (7.5YR 5/6) gravelly coarse sand; single grain; loose; strongly acid; clear smooth boundary.

IIC2—35 to 60 inches; strong brown (7.5YR 5/6) sand and coarse sand; single grain; loose; about 15 percent fine gravel; medium acid.

The depth to a contrasting layer of gravelly coarse sand or sand is 12 to 24 inches. The content of gravel varies. In most pedons, the greatest concentrations of gravel are within a depth of 50 inches.

The A horizon has hue of 10YR or 7.5YR, value of 2 or 3, and chroma of 1 to 3. It generally is sandy loam, but the range includes loam and gravelly sandy loam. The B horizon has hue of 10YR or 7.5YR, value of 3 or 4, and chroma of 2 to 4. It is medium acid or strongly acid. Calcareous material is at a depth of more than 90 inches.

Chelsea series

The Chelsea series consists of excessively drained, rapidly permeable soils on uplands and alluvial benches. These soils formed in sandy material deposited dominantly by wind but, in some areas, by water. The native vegetation was trees. Slope ranges from 2 to 9 percent.

Chelsea soils are similar to Sparta soils and commonly are adjacent to those soils. Sparta soils are dark to a greater depth than the Chelsea soils and have a darker A horizon. Their position on the landscape is similar to that of the Chelsea soils.

Typical pedon of Chelsea loamy fine sand, 5 to 9 percent slopes, 2,080 feet north and 690 feet east of the southwest corner of sec. 31, T. 87 N., R. 10 W.

A1—0 to 5 inches; very dark gray (10YR 3/1) loamy fine sand, gray (10YR 5/1) dry; weak fine granular structure; very friable; slightly acid; abrupt smooth boundary.

A21—5 to 22 inches; brown (10YR 4/3) loamy fine sand, brown (10YR 5/3) dry; weak medium and fine subangular blocky structure; very friable; strongly acid; clear smooth boundary.

A22—22 to 38 inches; brown (10YR 5/3) fine sand, pale brown (10YR 6/3) dry; single grain; loose; strongly acid; gradual smooth boundary.

A&B—38 to 60 inches; brown (10YR 5/3) fine sand; single grain; loose; 1/4- to 2-inch bands of brown (7.5YR 4/4) loamy fine sand at 38, 41, 45, 51, and 56 inches; massive; very friable; strongly acid.

The solum ranges from 48 to more than 60 inches in thickness. The A horizon ranges from loamy fine sand to fine sand. It is slightly acid to strongly acid. The A1 horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). It is 3 to 5 inches thick. In plowed areas the Ap horizon is dark grayish brown (10YR 4/2), dark brown (10YR 3/3), or brown (10YR 4/3). The lamellae in the A&B horizon have hue of 7.5YR or 10YR and value and chroma of 3 or 4. The depth of the uppermost lamella is 36 to 48 inches.

Clyde series

The Clyde series consists of poorly drained, moderately permeable soils in drainageways and the lower concave areas on uplands. These soils formed in 30 to 48 inches of loamy sediments and in the underlying glacial till. The native vegetation was prairie grasses and sedges or other water-tolerant plants. Slope ranges from 0 to 3 percent.

Clyde soils are similar to Floyd and Tripoli soils and commonly are adjacent to Floyd and Schley soils. Floyd soils are somewhat poorly drained. Their B horizon is browner than that of the Clyde soils. Tripoli soils are less stratified than the Clyde soils and are shallower to till. The surface layer of Schley soils is thinner than that of the Clyde soils. Floyd and Schley soils are higher on the landscape than the Clyde soils and are along drainageways.

Typical pedon of Clyde clay loam, 0 to 3 percent slopes, 1,650 feet south and 725 feet east of the northwest corner of sec. 17, T. 87 N., R. 10 W.

A1—0 to 16 inches; black (N 2/0) clay loam, very dark gray (N 3/0) dry; moderate fine granular structure; friable; neutral; clear smooth boundary.

A3—16 to 22 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; common fine distinct olive brown (2.5YR 4/4) mottles; weak medium subangular blocky structure; friable; neutral; clear smooth boundary.

B2g—22 to 32 inches; dark gray (5Y 4/1) loam; discontinuous very dark gray (10YR 3/1) coatings on faces of peds; few fine distinct gray (5Y 5/1) and common fine distinct olive brown (2.5Y 4/4) mottles; moderate medium and fine subangular blocky structure; friable; neutral; clear smooth boundary.

B31—32 to 36 inches; grayish brown (2.5Y 5/2) sandy loam; common medium and fine faint olive brown (2.5Y 4/4) mottles; weak coarse subangular blocky structure; very friable; few coarse pebbles; neutral; abrupt smooth boundary.

IIB32—36 to 50 inches; mottled yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) loam; weak coarse prismatic structure parting to moderate medium and fine subangular blocky; firm; few fine roots; neutral; gradual smooth boundary.

IIB33—50 to 60 inches; dark yellowish brown (10YR 4/4) loam; common fine distinct grayish brown (10YR 5/2) mottles; few grayish brown (10YR 5/2) mottles 1 inch or less in diameter surrounding some root channels; weak coarse subangular blocky structure; firm; neutral; gradual smooth boundary.

IIC—60 to 70 inches; dark yellowish brown (10YR 4/4) loam; common fine distinct grayish brown (10YR 5/2) mottles and streaks; massive; firm; common very fine red (2.5YR 4/6) oxides; neutral.

The thickness of the solum typically is 60 inches but ranges from 30 to 60 inches. The depth to glacial till ranges from 30 to 48 inches.

The A horizon is about 20 to 24 inches thick. It ranges from silty clay loam high in content of sand to clay loam or loam. The B horizon is dominantly clay loam or loam but in many pedons has strata of silty clay loam or layers of sandy loam, typically less than 6 inches thick. It is slightly acid in some pedons.

Coland series

The Coland series consists of poorly drained, moderately permeable soils on flood plains. These soils formed in moderately fine textured alluvial material 48 to 60 inches deep over coarse textured alluvial material. The native vegetation was grasses and sedges or other water-tolerant plants. Slope ranges from 0 to 2 percent.

Coland soils are similar to Spillville soils and commonly are adjacent to those soils. Spillville soils are moderately well drained or somewhat poorly drained. Their position on the landscape is similar to that of the Coland soils.

Typical pedon of Coland clay loam, in an area of Spillville-Coland complex, 0 to 2 percent slopes, 924 feet south and 264 feet west of the northeast corner of sec. 1, T. 88 N., R. 8 W.

A11—0 to 11 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; moderate fine granular structure; friable; neutral; clear smooth boundary.

A12—11 to 21 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; moderate medium and fine granular structure; friable; neutral; gradual smooth boundary.

A13—21 to 40 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; weak fine prismatic structure parting to weak medium subangular blocky; friable; neutral; clear smooth boundary.

A14—40 to 48 inches; very dark gray (10YR 3/1) clay loam; weak medium subangular blocky structure; friable; neutral; clear smooth boundary.

C—48 to 60 inches; dark gray (10YR 4/1) clay loam; many medium distinct brown (7.5YR 4/4) mottles; massive; friable; neutral.

The thickness of the solum ranges from 36 to 48 inches. The upper 48 inches or more does not contain coarse fragments.

The A horizon is neutral in hue or has hue of 10YR. It has value of 2 or 3 and chroma of 1 or less. It ranges from 36 to 48 inches in thickness. It typically is clay loam, but in some pedons the upper 10 inches is loam. The lower part of the A horizon and the B horizon, if it occurs, range from 27 to 35 percent clay. They range from 15 to 30 percent fine sand or coarse sand within a depth of 40 inches. The C horizon is dominantly clay loam but in some pedons has thin strata ranging from silty clay to loamy sand.

Cresco series

The Cresco series consists of moderately well drained soils on convex ridges and side slopes in the uplands. These soils formed in about 24 inches of loamy sediments and in the underlying very firm glacial till. Permeability is moderate in the sediments and moderately slow in the underlying glacial till. The native vegetation was prairie grasses. Slope ranges from 2 to 5 percent.

These soils are taxadjuncts to the Cresco series because the gray coatings on the faces of peds in the B horizon are more pronounced and thicker than is defined as the range for the series. Also, they have a slightly lower content of clay in this horizon and are not so slowly permeable. These differences, however, do not alter the use or behavior of the soils.

Cresco soils commonly are adjacent to Kenyon and Protivin soils. Kenyon soils contain less clay in the IIB horizon than the Cresco soils. Their position on the landscape is similar to that of the Cresco soils. Protivin soils are somewhat poorly drained and are downslope from the Cresco soils. Also, their subsoil is grayer.

Typical pedon of Cresco loam, 2 to 5 percent slopes, 35 feet east and 20 feet south of the center of sec. 23, T. 90 N., R. 8 W.

Ap—0 to 6 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; slightly acid; abrupt smooth boundary.

A12—6 to 12 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; medium acid; clear smooth boundary.

A3—12 to 16 inches; very dark grayish brown (10YR 3/2) loam; some brown (10YR 4/3) streaks; weak fine subangular blocky structure; friable; medium acid; clear smooth boundary.

B1—16 to 21 inches; brown (10YR 4/3) loam; weak fine subangular blocky structure; friable; thin nearly continuous very dark grayish brown (10YR 3/2) coatings on faces of peds; discontinuous stone line at 21 inches; medium acid; clear smooth boundary.

IIB12t—21 to 30 inches; yellowish brown (10YR 5/4) loam; moderate fine subangular blocky structure; firm; few thin discontinuous clay films on faces of peds; nearly continuous brown (10YR 4/3) coatings on faces of peds; slightly acid; abrupt smooth boundary.

IIB21t—30 to 38 inches; yellowish brown (10YR 5/4) clay loam; few fine distinct strong brown (7.5YR 5/6) mottles; moderate fine angular blocky structure; very firm; nearly continuous grayish brown (2.5Y 5/2) coatings on faces of peds; thin discontinuous clay films on faces of peds and in root channels; neutral; clear smooth boundary.

IIB22t—38 to 48 inches; mottled strong brown (7.5YR 5/6) and yellowish brown (10YR 5/4) clay loam; moderate medium prismatic structure parting to moderate medium angular and subangular blocky; very firm; thick nearly continuous grayish brown (2.5Y 5/2) coatings on faces of prisms and peds; thin discontinuous clay films on faces of peds and in root channels; few fine dark oxides; neutral; gradual smooth boundary.

IIB3—48 to 57 inches; mottled strong brown (7.5YR 5/6) and yellowish brown (10YR 5/6 and 5/4) clay loam; weak medium prismatic structure parting to moderate medium subangular blocky; very firm; thin discontinuous grayish brown (2.5Y 5/2) coatings on faces of peds; neutral; gradual smooth boundary.

IIC—57 to 60 inches; mottled strong brown (7.5YR 5/6) and yellowish brown (10YR 5/6 and 5/4) clay loam; massive; very firm; strong effervescence; mildly alkaline.

The solum is more than 40 inches thick. The depth to carbonates ranges from 40 to 70 inches.

The A1 and Ap horizons are black (10YR 2/1), very dark brown (10YR 2/2), or very dark gray (10YR 3/1). The upper part of the B horizon is brown (10YR 4/3) or dark yellowish brown (10YR 4/4). The content of clay in the IIB2 horizon generally ranges from 30 to 35 percent but in some pedons is as much as 37 percent in part of this horizon.

Dells series

The Dells series consists of somewhat poorly drained soils on alluvial benches. These soils formed in silty and loamy material about 30 to 40 inches deep over sand or loamy sand. Permeability is moderate in the subsoil and rapid in the substratum. The native vegetation was grasses and trees. Slope ranges from 0 to 2 percent.

Dells soils commonly are adjacent to Wapsie soils. They are in positions on the landscape similar to those of the adjacent soils. Wapsie soils contain more sand in

the upper part than the Dells soils. Also, their subsoil is browner.

Typical pedon of Dells silt loam, 0 to 2 percent slopes, 2,145 feet south and 230 feet east of the center of sec. 29, T. 90 N., R. 10 W.

Ap—0 to 9 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; some grayish brown (10YR 5/2) streaks in the lower part; weak fine granular structure; friable; neutral; abrupt smooth boundary.

A2—9 to 12 inches; grayish brown (10YR 5/2) silt loam, light gray (10YR 7/2) dry; common fine distinct brown (7.5YR 4/4) mottles; weak thin platy structure; friable; common fine dark oxides; slightly acid; clear smooth boundary.

B21—12 to 20 inches; yellowish brown (10YR 5/4) silt loam; common fine distinct grayish brown (10YR 5/2) and brown (7.5YR 4/4) mottles; weak fine subangular blocky structure; friable; medium acid; clear smooth boundary.

B22t—20 to 27 inches; yellowish brown (10YR 5/4) silt loam; common fine distinct grayish brown (10YR 5/2) mottles; weak medium prismatic structure parting to moderate fine angular and subangular blocky; friable; thin discontinuous clay films; discontinuous light brownish gray (10YR 6/2) silt coatings on faces of peds when dry; medium acid; gradual wavy boundary.

IIB31t—27 to 30 inches; mottled grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) loam; few fine distinct brown (7.5YR 5/4) mottles; weak medium subangular blocky structure; friable; few patchy clay films; discontinuous light brownish gray (10YR 6/2) silt and sand coatings on faces of peds when dry; some fine pebbles; medium acid; gradual wavy boundary.

IIB32t—30 to 34 inches; yellowish brown (10YR 5/6) sandy loam; few medium distinct brown (7.5YR 4/4) mottles; weak medium subangular blocky structure; very friable; some clay bridging between sand grains; few fine pebbles; some coarse sand; strongly acid; gradual wavy boundary.

IIC—34 to 60 inches; strong brown (7.5YR 5/6) loamy sand; single grain; loose; some fine pebbles; some coarse sand; medium acid.

The solum ranges from 20 to 36 inches in thickness. The upper part formed in material in which the content of sand coarser than very fine sand is less than 15 percent. The depth to a contrasting texture generally is 30 to 40 inches.

The Ap or A1 horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. In the A2 horizon the values are higher than those in the Ap or A1 horizon. The B21 horizon has hue of 10YR and value of 4 or 5. The B2t horizon has hue of 10YR, value of 4 or 5, and chroma of 2 to 5. It is silt loam or silty clay loam. The IIB3 horizon is sandy loam or loam. The IIC horizon has hue of 10YR or 7.5YR and value and chroma of 4 to 8. It is loamy sand or sand.

Dickinson series

The Dickinson series consists of somewhat excessively drained soils on uplands and alluvial benches. These soils formed in moderately coarse textured and coarse textured eolian material. Permeability is moderately rapid in the upper part and rapid in the lower part. The native vegetation was prairie grasses. Slope ranges from 0 to 5 percent.

Dickinson soils are similar to Lamont soils and commonly are adjacent to Bertram, Kenyon, Olin, and Sparta soils. They are in positions on the landscape similar to those of the adjacent soils. The A horizon of Lamont soils is thinner and lighter colored than that of the Dickinson soils. Sparta soils contain more sand in the A and B horizons than the Dickinson soils. The solum of Bertram soils is 20 to 40 inches deep over limestone bedrock. Kenyon and Olin soils formed in glacial till.

Typical pedon of Dickinson fine sandy loam, 2 to 5 percent slopes, 1,275 feet north and 150 feet west of the center of sec. 8, T. 88 N., R. 9 W.

Ap—0 to 8 inches; black (10YR 2/1) fine sandy loam, dark gray (10YR 4/1) dry; weak fine granular structure; very friable; neutral; abrupt smooth boundary.

A12—8 to 14 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; very friable; slightly acid; clear smooth boundary.

A3—14 to 19 inches; very dark grayish brown (10YR 3/2) fine sandy loam; some dark brown (10YR 3/3) streaks; weak fine subangular blocky structure; very friable; slightly acid; clear smooth boundary.

B1—19 to 26 inches; brown (10YR 4/3) fine sandy loam; nearly continuous dark brown (10YR 3/3) coatings on faces of peds; weak medium and fine subangular blocky structure; very friable; some very dark gray (10YR 3/1) filled root channels; slightly acid; gradual smooth boundary.

B2—26 to 33 inches; dark yellowish brown (10YR 4/4) fine sandy loam; discontinuous brown (10YR 4/3) coatings on faces of peds; weak medium subangular blocky structure; very friable; slightly acid; gradual wavy boundary.

B3—33 to 45 inches; yellowish brown (10YR 5/4) loamy fine sand; discontinuous dark yellowish brown (10YR 4/4) coatings on faces of peds; weak medium subangular blocky structure; very friable; slightly acid; gradual wavy boundary.

C—45 to 60 inches; yellowish brown (10YR 5/6) fine sand; single grain; loose; medium acid.

The thickness of the solum ranges from 24 to 50 inches. The depth to loamy fine sand or sand is 24 to 42 inches. The soils typically are free of gravel throughout.

The A horizon is black (10YR 2/1), very dark brown (10YR 2/2), very dark grayish brown (10YR 3/2), or dark brown (10YR 3/3). It is 10 to 24 inches thick. The lower part of the B horizon has chroma of 4 to 6. The C horizon ranges from loamy sand to fine sand.

Dinsdale series

The Dinsdale series consists of well drained, moderately permeable soils on convex ridges and side slopes in the uplands. These soils formed in about 24 to 30 inches of loess and in the underlying glacial till. The native vegetation was prairie grasses. Slope ranges from 2 to 5 percent.

Dinsdale soils commonly are adjacent to Kenyon and Klinger soils. Kenyon soils contain more sand in the upper part than the Dinsdale soils and are shallower to glacial till. Their position on the landscape is similar to that of the Dinsdale soils. The somewhat poorly drained Klinger soils are in the less sloping areas. Their B horizon is grayer than that of the Dinsdale soils.

Typical pedon of Dinsdale silt loam, 2 to 5 percent slopes, 10 feet south and 790 feet west of the northeast corner of sec. 2, T. 89 N., R. 10 W.

Ap—0 to 7 inches; black (10YR 2/1) silt loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; medium acid; abrupt smooth boundary.

A12—7 to 11 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; weak fine granular structure; friable; medium acid; clear smooth boundary.

A3—11 to 15 inches; very dark grayish brown (10YR 3/2) silt loam, dark grayish brown (10YR 4/2) dry; mixed with some brown (10YR 4/3) silty clay loam; weak fine subangular blocky structure; friable; medium acid; clear smooth boundary.

B1t—15 to 25 inches; brown (10YR 4/3) silty clay loam; moderate fine subangular blocky structure; friable; discontinuous very dark grayish brown (10YR 3/2) coatings on faces of peds; few fine discontinuous clay films; medium acid; clear wavy boundary.

IIB21t—25 to 32 inches; yellowish brown (10YR 5/6) loam; few fine faint strong brown (7.5YR 5/6) mottles; weak medium and fine subangular blocky structure; firm; some discontinuous brown (10YR 4/3) coatings on faces of peds; few thin discontinuous clay films; stone line at 25 inches; medium acid; clear smooth boundary.

IIB22t—32 to 42 inches; yellowish brown (10YR 5/6) loam; common fine distinct strong brown (7.5YR 5/6) mottles; moderate medium angular and subangular blocky structure; firm; few thin discontinuous clay films; few fine dark oxides; thin discontinuous light brownish gray (10YR 6/2) sand coatings on faces of peds when dry; medium acid; gradual smooth boundary.

IIB3—42 to 48 inches; yellowish brown (10YR 5/6) loam; common fine distinct strong brown (7.5YR 5/6) mottles; moderate medium subangular blocky structure; firm; few fine dark oxides; medium acid; gradual smooth boundary.

IIC—48 to 60 inches; yellowish brown (10YR 5/6) loam; some brownish yellow (10YR 6/8) streaks; massive; firm; medium acid.

The thickness of the solum dominantly is about 50 inches but ranges from 40 to 60 inches. The thickness of the loess dominantly is 24 to 28 inches but ranges from 20 to 30 inches.

The A horizon is black (10YR 2/1), very dark brown (10YR 2/2), or very dark grayish brown (10YR 3/2). It generally ranges from 10 to 20 inches in thickness but is thinner in eroded areas. The B horizon formed in loess. It is dark brown (10YR 3/3), brown (10YR 4/3), or dark yellowish brown (10YR 4/4). The clay content in this horizon is about 27 to 30 percent. The IIB and IIC horizons formed in glacial till. They have hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 4 to 8. They typically are loam, but the range includes sandy clay loam and clay loam. In many pedons a stone line or a layer of sandy loam or loamy sand as much as 5 inches thick is between the loess and the glacial till.

Donnan series

The Donnan series consists of moderately well drained and somewhat poorly drained soils on convex side slopes in the uplands. These soils formed in about 20 to 40 inches of loamy sediments and in the underlying clayey glacial till. They are moderately permeable in the upper part and very slowly permeable in the lower part. The native vegetation was prairie grasses and trees. Slope ranges from 2 to 6 percent.

Donnan soils commonly are adjacent to Bassett, Dinsdale, Kenyon, and Oran soils. The adjacent soils contain less clay in the IIB horizon than the Donnan soils. Also, they are higher on the landscape.

Typical pedon of Donnan loam, 2 to 6 percent slopes, 460 feet north and 300 feet west of the southeast corner of sec. 28, T. 88 N., R. 10 W.

Ap—0 to 6 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; moderate fine granular structure; friable; neutral; abrupt smooth boundary.

A12—6 to 9 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

A2—9 to 14 inches; dark grayish brown (10YR 4/2) loam, light brownish gray (10YR 6/2) dry; discontinuous dark gray (10YR 4/1) coatings on faces of peds in the upper part; weak medium platy

structure parting to weak fine subangular blocky; friable; strongly acid; clear smooth boundary.

B1—14 to 21 inches; brown (10YR 4/3) loam; discontinuous dark grayish brown (10YR 4/2) coatings on faces of peds; few fine faint dark grayish brown (10YR 4/2) and brown (7.5YR 4/4) mottles; moderate fine subangular blocky structure; friable; strongly acid; clear smooth boundary.

IIB21t—21 to 30 inches; grayish brown (2.5Y 5/2) clay; many fine prominent red (2.5YR 4/6) mottles; moderate medium prismatic structure parting to moderate fine subangular blocky; extremely firm; discontinuous clay films on faces of peds; medium acid; gradual smooth boundary.

IIB22t—30 to 39 inches; light brownish gray (2.5Y 6/2) clay; common fine distinct red (2.5YR 4/6) and few fine distinct olive brown (2.5Y 4/4) mottles; moderate medium prismatic structure parting to moderate medium angular and subangular blocky; extremely firm; discontinuous clay films on faces of peds; medium acid; gradual smooth boundary.

IIB3—39 to 48 inches; light brownish gray (2.5Y 6/2) clay loam; common fine faint olive brown (2.5Y 4/4) mottles; moderate medium prismatic structure parting to moderate medium angular blocky; very firm; medium acid; gradual smooth boundary.

IIC—48 to 60 inches; mottled olive brown (2.5Y 4/4) and light brownish gray (2.5Y 6/2) clay loam; massive; firm; common fine dark oxides; medium acid.

The thickness of the solum ranges from 40 to more than 80 inches. The depth to glacial till ranges from 20 to 40 inches. The A horizon ranges from loam or silt loam high in content of sand to clay loam or silty clay loam high in content of sand. The A1 and Ap horizons are very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). In uneroded areas the A2 horizon is dark grayish brown (10YR 4/2) or grayish brown (10YR 5/2) and is 2 to 5 inches thick.

The B and IIB horizons are medium acid or strongly acid. The B horizon is clay loam, loam, or silt loam high in content of sand. It has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 3 or 4. In many pedons it has mottles with chroma of 1 or 2. The IIB horizon is clay or clay loam. It has hue of 5Y or 2.5Y, value of 5 or 6, and chroma of 1 or 2 and commonly has higher chroma mottles.

Finchford series

The Finchford series consists of excessively drained, very rapidly permeable soils on alluvial benches and the adjacent escarpments. These soils formed in sandy alluvium and contain coarse sand and fine gravel throughout the solum. The native vegetation was drought-tolerant grasses. Slope ranges from 0 to 9 percent.

Finchford soils are similar to Flagler and Lilah soils and commonly are adjacent to those soils. They are in positions on the landscape similar to those of the adjacent soils. Flagler and Lilah soils are deeper to coarse sand and gravel than the Finchford soils. Also, their A horizon contains less sand.

Typical pedon of Finchford loamy sand, 0 to 2 percent slopes, 100 feet south and 1,300 feet west of the northeast corner of sec. 7, T. 89 N., R. 9 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loamy sand, dark grayish brown (10YR 4/2) dry; weak fine granular structure; very friable; about 5 percent medium and fine gravel; slightly acid; abrupt smooth boundary.

A3—8 to 22 inches; very dark grayish brown (10YR 3/2) loamy sand, dark grayish brown (10YR 4/2) dry; weak medium and coarse subangular blocky structure; loose; about 5 percent medium and fine gravel; slightly acid; clear smooth boundary.

B1—22 to 30 inches; brown (10YR 4/3) loamy sand; weak medium subangular blocky structure; loose; about 5 percent medium and fine gravel; medium acid; gradual wavy boundary.

B2—30 to 35 inches; dark yellowish brown (10YR 4/4) gravelly loamy sand; weak medium subangular blocky structure; loose; few discontinuous brown coatings on faces of peds; about 20 percent medium and fine gravel; medium acid; clear wavy boundary.

B3—35 to 40 inches; yellowish brown (10YR 5/6 and 5/4) sand; weak medium subangular blocky structure; loose; about 5 percent medium and fine gravel; medium acid; clear wavy boundary.

C—40 to 60 inches; yellowish brown (10YR 5/6) gravelly sand; single grain; loose; about 30 percent gravel; medium acid.

The thickness of the solum ranges from 24 to 40 inches. The texture ranges from loamy sand to sand throughout the profile. The content of fine gravel is less than 5 percent in some pedons, but 50 percent or more of the sand particles are medium or coarse.

The A horizon is very dark brown (10YR 2/2) or very dark grayish brown (10YR 3/2). It is 10 to 30 inches thick. The B horizon has hue of 10YR or 7.5YR, value of 3 or more, and chroma of 2 or more. It is medium acid or strongly acid. The C horizon has hue of 7.5YR or 10YR and value and chroma of 4 or more.

Flagler series

The Flagler series consists of somewhat excessively drained soils on alluvial benches. These soils formed in about 24 to 36 inches of moderately coarse textured alluvium and in loamy sand or sand and some gravel. Permeability is moderately rapid in the upper part and

very rapid in the lower part. The native vegetation was prairie grasses. Slope ranges from 0 to 5 percent.

Flagler soils are similar to Saude and Wapsie soils and commonly are adjacent to Finchford and Saude soils. They are in positions on the landscape similar to those of the adjacent soils. The A and B horizons of Saude and Wapsie soils contain less sand than those of the Flagler soils. The A horizon of Finchford soils contains more gravel than that of the Flagler soils. Also, the A horizon and the upper part of the B horizon contain more sand.

Typical pedon of Flagler sandy loam, 0 to 2 percent slopes, 1,358 feet south and 890 feet east of the northwest corner of sec. 31, T. 90 N., R. 7 W.

Ap—0 to 7 inches; very dark brown (10YR 2/2) sandy loam, very dark grayish brown (10YR 3/2) dry; moderate fine granular structure; very friable; neutral; abrupt smooth boundary.

A12—7 to 13 inches; very dark brown (10YR 2/2) sandy loam, dark grayish brown (10YR 4/2) dry; weak medium subangular blocky structure; very friable; neutral; gradual smooth boundary.

A3—13 to 19 inches; very dark grayish brown (10YR 3/2) sandy loam, dark grayish brown (10YR 4/2) dry; some brown (10YR 4/3) streaks; weak medium subangular blocky structure; very friable; slightly acid; gradual smooth boundary.

B2—19 to 25 inches; brown (10YR 4/3) sandy loam; weak medium subangular blocky structure; very friable; discontinuous very dark grayish brown (10YR 3/2) coatings on faces of peds; slightly acid; clear wavy boundary.

B3—25 to 30 inches; yellowish brown (10YR 5/4) loamy sand; weak coarse subangular blocky structure; very friable; few fine pebbles; medium acid; clear wavy boundary.

IIC—30 to 60 inches; yellowish brown (10YR 5/6) sand; loose; single grain; concentrations of fine gravel at 30 to 32 inches; medium acid.

The thickness of the solum ranges from 30 to 50 inches. The depth to loamy sand, gravelly sand, or sand ranges from 24 to 36 inches.

The thickness of the A horizon ranges from about 12 to 24 inches. The A1 and Ap horizons are very dark brown (10YR 2/2) or very dark grayish brown (10YR 3/2). The B horizon is slightly acid or medium acid. The B2 horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. The content of clay in this horizon ranges from 10 to 18 percent and the content of sand 60 to 70 percent. The IIC horizon has hue of 10YR or 7.5Y, value of 4 or 5, and chroma of 4 to 8. It is medium acid or strongly acid. It is gravelly sand, gravelly loamy sand, or sand. The content of gravel, by volume, is more than 15 percent.

Floyd series

The Floyd series consists of somewhat poorly drained, moderately permeable soils on concave foot slopes and in coves on uplands. These soils formed in 30 to 45 inches of loamy sediments and in the underlying glacial till. The native vegetation was prairie grasses and water-tolerant plants. Slope ranges from 1 to 4 percent.

Floyd soils are similar to Clyde and Schley soils and commonly are adjacent to Clyde, Kenyon, Oran, and Readlyn soils. They are in positions on the landscape similar to those of the adjacent soils. Clyde soils are poorly drained. Their B horizon is grayer than that of the Floyd soils. The A horizon of Schley and Oran soils is thinner and lighter colored than that of the Floyd soils. Kenyon, Oran, and Readlyn soils are not stratified and are shallower to glacial till than the Floyd soils. Also, Kenyon soils are browner in the upper part of the subsoil and are moderately well drained.

Typical pedon of Floyd loam, 1 to 4 percent slopes, 1,385 feet south and 330 feet east of the northwest corner of sec. 17, T. 87 N., R. 10 W.

A1—0 to 12 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; neutral; clear smooth boundary.

A3—12 to 18 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; neutral; gradual smooth boundary.

B1—18 to 22 inches; dark grayish brown (10YR 4/2) loam; discontinuous very dark grayish brown (10YR 3/2) coatings on faces of peds; common fine distinct olive brown (2.5Y 4/4) mottles; weak fine subangular blocky structure; friable; neutral; gradual smooth boundary.

B21—22 to 28 inches; dark grayish brown (10YR 4/2) loam; common fine distinct olive brown (2.5Y 4/4) and few fine distinct grayish brown (2.5Y 5/2) mottles; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

B22—28 to 34 inches; mottled brown (7.5YR 4/4), yellowish brown (10YR 5/6), and grayish brown (10YR 5/2) sandy loam; weak medium and fine subangular blocky structure; very friable; few fine pebbles; neutral; abrupt wavy boundary.

IIB31—34 to 42 inches; grayish brown (10YR 5/2) loam; common fine distinct brown (7.5YR 4/4) mottles; weak coarse subangular blocky structure parting to weak medium subangular blocky; firm; few dark oxides; neutral; gradual smooth boundary.

IIB32—42 to 58 inches; mottled yellowish brown (10YR 5/6), brown (7.5YR 4/4), and grayish brown (10YR 5/2) loam; moderate medium prismatic structure; firm; few dark oxides; continuous thick grayish brown (10YR 5/2) silt and sand coatings on faces of prisms; neutral; gradual smooth boundary.

IIC—58 to 60 inches; brown (7.5YR 4/4) loam; few fine distinct strong brown (7.5YR 5/6) and common medium and fine grayish brown (10YR 5/2) mottles; massive; firm; neutral.

The thickness of the solum ranges from about 40 to 60 inches. The depth to carbonates ranges from 50 to 80 inches. The depth to loam glacial till ranges from 30 to 45 inches. In some pedons a stone line is between the sediments and glacial till.

The A1 horizon is black (10YR 2/1 or N 2/0) or very dark gray (10YR 3/1). The A3 horizon ranges from very dark gray (10YR 3/1) to very dark grayish brown (2.5Y 3/2). The A horizon typically is loam, but the range includes silt loam high in content of sand, clay loam, and silty clay loam high in content of sand. The B horizon has hue of 2.5Y, 7.5YR, or 10YR, value of 4 or 5, and chroma of 2 to 6. It is dominantly loam, silty clay loam, or clay loam but in many pedons has a thin layer of sandy loam that averages more than 18 percent clay.

Franklin series

The Franklin series consists of somewhat poorly drained, moderately permeable soils on broad ridges in the uplands. These soils formed in 18 to 30 inches of loess and in the underlying glacial till. The native vegetation was prairie grasses and trees. Slope ranges from 1 to 3 percent.

Franklin soils are similar to Klinger soils and commonly are adjacent to Dinsdale, Klinger, and Maxfield soils. The adjacent soils are in positions on the landscape similar to those of the Franklin soils. Their dark A horizon is thicker than that of the Franklin soils. Dinsdale soils are well drained. Maxfield soils are poorly drained.

Typical pedon of Franklin silt loam, 1 to 3 percent slopes, 20 feet south and 1,056 feet east of the northwest corner of sec. 28, T. 90 N., R. 10 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silt loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

A21—8 to 11 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak thin platy structure parting to weak fine granular; friable; few thin discontinuous very dark gray (10YR 3/1) coatings on faces of peds; slightly acid; clear smooth boundary.

A22—11 to 14 inches; grayish brown (10YR 5/2) silt loam, light gray (10YR 7/2) dry; few fine distinct yellowish brown (10YR 5/6) mottles; weak thin platy structure parting to weak fine subangular blocky; friable; few dark oxides; strongly acid; clear smooth boundary.

B21—14 to 19 inches; grayish brown (10YR 5/2) silty clay loam; common fine distinct yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; strongly acid; abrupt wavy boundary.

IIB22t—19 to 32 inches; mottled light brownish gray (2.5Y 6/2) and yellowish brown (10YR 5/6) loam; moderate medium subangular blocky structure; firm; nearly continuous grayish brown (2.5Y 5/2) sand and silt coatings on faces of peds when dry; some clay filled root channels; thin discontinuous clay films; few dark oxides; strongly acid; gradual smooth boundary.

IIB3t—32 to 47 inches; mottled light brownish gray (2.5Y 6/2) and yellowish brown (10YR 5/6) loam; weak coarse prismatic structure parting to weak coarse subangular blocky; firm; nearly continuous grayish brown (2.5Y 5/2) sand and silt coatings on faces of prisms when dry; many clay filled root channels; dark oxide concentrations as much as 2 millimeters in size at 33 to 36 inches; strongly acid; gradual smooth boundary.

IIC—47 to 60 inches; mottled light brownish gray (2.5Y 6/2) and yellowish brown (10YR 5/6) loam; massive; firm; medium acid.

The solum ranges from 40 to about 70 inches in thickness. It formed partly in loess and partly in glacial till. The loess dominantly is 18 to 26 inches thick but is as much as 30 inches thick in some pedons.

The Ap horizon is black (10YR 2/1), very dark gray (10YR 3/1), or very dark grayish brown (10YR 3/2). It is 6 to 9 inches thick. The A2 horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2. It is about 4 to 8 inches thick.

The B and IIB horizons are medium acid or strongly acid. The B horizon is dark grayish brown (10YR 4/2 or 2.5Y 4/2), grayish brown (10YR 5/2), or olive brown (2.5Y 5/4) and has higher chroma mottles. The content of clay in this horizon ranges from 28 to 34 percent. In some pedons a stone line or a thin lens of sandy material as much as 5 inches thick is 18 to 30 inches from the surface and separates the B horizon from the IIB horizon. The IIB horizon has hue of 10YR, 2.5Y, or 7.5YR, value of 4 to 6, and chroma of 2 to 8. It typically is loam, but the range includes clay loam or sandy clay loam.

Hayfield series

The Hayfield series consists of somewhat poorly drained soils on alluvial benches. These soils formed in loamy alluvial material 24 to 32 inches deep over coarse textured alluvium. They are moderately permeable in the upper part and rapidly permeable in the substratum. The native vegetation was prairie grasses and trees. Slope ranges from 0 to 2 percent.

Hayfield soils are similar to Lawler soils and commonly are adjacent to Lawler, Marshan, and Waukee soils. They are in positions on the landscape similar to those of the adjacent soils. The A horizon of Lawler soils is

thicker than that of the Hayfield soils. Marshan soils are poorly drained. Their B horizon is grayer than that of the Hayfield soils. Waukee soils are well drained. Their B horizon is browner than that of the Hayfield soils.

Typical pedon of Hayfield loam, 24 to 32 inches to sand and gravel, 0 to 2 percent slopes, 924 feet north and 100 feet west of the center of sec. 18, T. 89 N., R. 9 W.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; slightly acid; abrupt smooth boundary.

A12—6 to 9 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; some brown (10YR 4/3) streaks; weak fine granular structure; friable; slightly acid; abrupt smooth boundary.

A2—9 to 12 inches; dark grayish brown (10YR 4/2) loam, grayish brown (10YR 5/2) dry; some brown (10YR 4/3) streaks; weak medium platy structure parting to weak fine granular; friable; nearly continuous very dark grayish brown (10YR 3/2) coatings on faces of peds; slightly acid; abrupt smooth boundary.

B21t—12 to 17 inches; brown (10YR 4/3) loam; weak fine subangular blocky structure; friable; few thin discontinuous clay films on faces of peds; discontinuous very dark grayish brown (10YR 3/2) coatings on faces of peds and in root channels; medium acid; clear smooth boundary.

B22t—17 to 25 inches; brown (10YR 4/3) loam; few fine distinct dark grayish brown (10YR 4/2) and olive (5Y 4/4) mottles; moderate medium and fine subangular blocky structure; friable; few thin discontinuous clay films on faces of peds and in root channels; medium acid; clear smooth boundary.

B3—25 to 30 inches; dark yellowish brown (10YR 4/4) sandy loam; few fine distinct grayish brown (10YR 5/2) and brown (7.5YR 4/4) mottles; weak medium angular and subangular blocky structure; friable; medium acid; gradual wavy boundary.

IIC—30 to 60 inches; yellowish brown (10YR 5/6) sand; common fine distinct grayish brown (10YR 5/2) mottles; single grain; loose; less than 5 percent gravel; medium acid.

The thickness of the solum ranges from about 24 to 50 inches. The depth to the IIC horizon ranges from about 24 to 32 inches.

The A1 and Ap horizons range from 6 to 10 inches in thickness. They have hue of 10YR, value of 2 or 3, and chroma of 1 or 2. The A2 horizon has value of 4 or 5 and chroma of 2 or 3. It is 3 to 7 inches thick. The B horizon has hue of 10YR or 2.5Y, value of 3 to 5, and chroma of 2 to 4. It is neutral or medium acid. It is loam, silt loam high in content of sand, clay loam, or sandy loam. The C horizon has hue of 10YR or 2.5Y, value of 4 to 6, and chroma of 2 to 6. It is loamy sand, coarse sand, or sand and some gravel. The content of gravel in this horizon ranges from less than 1 percent to about 20 percent.

Kenyon series

The Kenyon series consists of moderately well drained, moderately permeable soils on convex ridges and side slopes in the uplands. These soils formed in about 14 to 24 inches of loamy sediments and in the underlying glacial till. The native vegetation was prairie grasses. Slope ranges from 2 to 9 percent.

Kenyon soils are similar to Bassett soils and commonly are adjacent to Bassett, Oran, Readlyn, and Tripoli soils. The A horizon of Basset and Oran soils is thinner than that of the Kenyon soils. Bassett soils are in positions on the landscape similar to those of the Kenyon soils. Oran, Readlyn, and Tripoli soils generally are less sloping than the Kenyon soils and are higher on the landscape and more poorly drained. Also, the upper part of the B horizon is grayer.

Typical pedon of Kenyon loam, 2 to 5 percent slopes, 1,680 feet south and 100 feet east of the northwest corner of sec. 17, T. 87 N., R. 10 W.

Ap—0 to 7 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

A12—7 to 14 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; friable; neutral; clear smooth boundary.

A3—14 to 20 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable; neutral; gradual smooth boundary.

B1—20 to 26 inches; brown (10YR 4/3) loam; nearly continuous very dark grayish brown (10YR 3/2) coatings on faces of peds; weak coarse subangular blocky structure parting to weak fine subangular blocky; friable; neutral; clear smooth boundary.

IIB21—26 to 33 inches; dark yellowish brown (10YR 4/4) loam; nearly continuous brown (10YR 4/3) coatings on faces of peds; weak medium prismatic structure parting to moderate fine subangular blocky; firm; weak stone line at 26 inches; medium acid; gradual smooth boundary.

IIB22—33 to 40 inches; yellowish brown (10YR 5/4) loam; discontinuous brown (10YR 5/3) coatings on faces of peds; few fine distinct brown (7.5YR 4/4) mottles; moderate medium prismatic structure parting to moderate fine angular and subangular blocky; firm; few fine dark oxides; strongly acid; gradual smooth boundary.

IIB3—40 to 45 inches; yellowish brown (10YR 5/4) loam; nearly continuous brown (10YR 5/3) coatings on faces of prisms; common fine distinct grayish brown

(10YR 5/2) and few medium distinct brown (7.5YR 4/4) mottles; weak medium and coarse prismatic structure parting to moderate medium subangular and angular blocky; firm; common fine dark oxides; slightly acid; gradual smooth boundary.

IIC—45 to 60 inches; mottled brown (7.5YR 4/4) and grayish brown (10YR 5/2) loam; massive; firm; neutral.

The thickness of the solum ranges from 45 to 60 inches. In uneroded areas the A horizon ranges from about 10 to 20 inches in thickness. It typically is loam, but the range includes silt loam high in content of sand. The A1 horizon is black (10YR 2/1) or very dark brown (10YR 2/2). The B horizon has hue of 10YR, value of 3 to 5, and chroma of 3 to 6. The IIB horizon has hue of 10YR, value of 4 or 5, and chroma of 3 to 8 and has mottles with chroma of 2 or less. It is slightly acid to strongly acid. The IIC horizon is similar in color to the IIB horizon, but the grayish mottles are more common.

Klinger series

The Klinger series consists of somewhat poorly drained, moderately permeable soils on broad ridges in the uplands. These soils formed in 22 to 30 inches of loess and in the underlying glacial till. The native vegetation was prairie grasses. Slope ranges from 1 to 3 percent.

Klinger soils are similar to Franklin soils and commonly are adjacent to Dinsdale, Franklin, and Maxfield soils. Franklin soils are in positions on the landscape similar to those of the Klinger soils. Their A horizon is thinner than that of the Klinger soils. Dinsdale soils are well drained. They generally are more sloping than the Klinger soils and are lower on the landscape. Also, their B horizon is browner. Maxfield soils are poorly drained. They generally are less sloping than the Klinger soils and are higher on the landscape. Also, their B horizon is grayer.

Typical pedon of Klinger silty clay loam, 1 to 3 percent slopes, 990 feet north and 925 feet west of the southeast corner of sec. 2, T. 89 N., R. 10 W.

Ap—0 to 7 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; friable; neutral; abrupt smooth boundary.

A12—7 to 13 inches; black (10YR 2/1) silty clay loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; medium acid; clear smooth boundary.

B1—13 to 18 inches; dark grayish brown (10YR 4/2) silty clay loam; common fine distinct dark yellowish brown (10YR 4/4) and few fine distinct yellowish brown (10YR 5/6) mottles; weak fine subangular blocky structure; friable; nearly continuous very dark grayish brown (10YR 3/2) coatings on faces of peds; medium acid; gradual smooth boundary.

B21t—18 to 25 inches; olive brown (2.5Y 4/4) silty clay loam; common fine distinct dark grayish brown (10YR 4/2) and yellowish brown (10YR 5/6) mottles; moderate fine subangular blocky structure; friable; some discontinuous very dark grayish brown (10YR 3/2) coatings on faces of peds and in root channels; few thin discontinuous clay films; medium acid; clear wavy boundary.

IIB22t—25 to 30 inches; mottled grayish brown (10YR 5/2) and strong brown (7.5YR 5/6) sandy loam; weak fine angular and subangular blocky structure; friable; some very dark grayish brown (10YR 3/2) clay filled root channels; medium acid; gradual smooth boundary.

IIB3t—30 to 43 inches; mottled grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) loam; few fine distinct dark brown (7.5YR 3/2) mottles; moderate medium and fine subangular blocky structure; firm; few very dark grayish brown (10YR 3/2) clay filled root channels; few dark oxides; slightly acid; gradual smooth boundary.

IIC1—43 to 47 inches; mottled grayish brown (10YR 5/2), yellowish brown (10YR 5/6), and strong brown (7.5YR 5/6) loam; massive; firm; neutral; gradual smooth boundary.

IIC2—47 to 60 inches; yellowish brown (10YR 5/6) loam; common fine distinct grayish brown (10YR 5/2) and strong brown (7.5YR 5/8) mottles; massive; firm; common fine lime nodules; moderate effervesence; mildly alkaline.

The thickness of the solum ranges from about 40 to 60 inches. The loess is 22 to 30 inches thick.

The A horizon is black (10YR 2/1) or very dark brown (10YR 2/2). It ranges from 12 to 22 inches in thickness. The B and IIB horizons are medium acid or slightly acid. The content of clay in the B2t horizon ranges from 28 to 35 percent. In some pedons a stone line or a lens of sandy material as much as 5 inches thick is 22 to 30 inches from the surface. The IIBt horizon has value of 4 or 5 and chroma of 2 and has higher chroma mottles. It is loam, clay loam, or sandy loam.

Lamont series

The Lamont series consists of well drained soils on uplands and on high alluvial benches. These soils formed in moderately coarse textured eolian material. Permeability is moderately rapid in the subsoil and rapid in the substratum. The native vegetation was trees. Slope ranges from 0 to 5 percent.

Lamont soils are similar to Dickinson soils and commonly are adjacent to Chelsea and Dickinson soils. They are in positions on the landscape similar to those of the adjacent soils. The A horizon of Dickinson soils is thicker and darker than that of the Lamont soils. Chelsea soils are coarser textured in the upper part of the solum than the Lamont soils.

Typical pedon of Lamont fine sandy loam, 2 to 5 percent slopes, 1,750 feet east and 495 feet south of the center of sec. 28, T. 90 N., R. 10 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) fine sandy loam, light brownish gray (10YR 6/2) dry; some brown (10YR 4/3) streaks; weak fine granular structure; friable; slightly acid; abrupt smooth boundary.

A21—8 to 11 inches; brown (10YR 5/3) fine sandy loam, light brownish gray (10YR 6/2) dry; weak fine subangular blocky structure parting to moderate fine granular; very friable; discontinuous very dark grayish brown (10YR 3/2) coatings on faces of peds in the upper part; medium acid; clear smooth boundary.

A22—11 to 14 inches; brown (10YR 5/3) fine sandy loam, pale brown (10YR 6/3) dry; weak thin platy structure parting to weak fine subangular blocky; very friable; discontinuous sand coatings on faces of peds, light gray (10YR 7/2) dry; medium acid; clear smooth boundary.

B1—14 to 20 inches; yellowish brown (10YR 5/4) fine sandy loam; weak medium subangular blocky structure; very friable; medium acid; clear smooth boundary.

B2t—20 to 29 inches; dark yellowish brown (10YR 4/4) sandy loam; weak medium subangular blocky structure; friable; discontinuous dark yellowish brown clay films on faces of peds; medium acid; clear smooth boundary.

B3t—29 to 36 inches; yellowish brown (10YR 5/6) sandy loam; weak coarse subangular blocky structure; very friable; discontinuous dark yellowish brown (10YR 4/4) clay films; strongly acid; clear smooth boundary.

C—36 to 60 inches; yellowish brown (10YR 5/6) loamy sand; single grain; loose; at 44 inches, a 2-inch band of strong brown (7.5YR 5/6) loamy sand that has few dark oxides; medium acid.

The solum ranges from 24 to 50 inches in thickness. The A1 or Ap horizon is dark grayish brown (10YR 4/2), dark gray (10YR 4/1), very dark gray (10YR 3/1), or very dark grayish brown (10YR 3/2). In uneroded areas the A2 horizon is dark grayish brown (10YR 4/2), grayish brown (10YR 5/2), or brown (10YR 5/3). The B horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 6. It is medium acid or strongly acid. The B2 horizon ranges from sandy loam to loam or sandy clay loam.

Lawler series

The Lawler series consists of somewhat poorly drained soils on alluvial benches. These soils formed in about 24 to 40 inches of loamy alluvial material and in the underlying coarse textured alluvium. They are moderately permeable in the upper part and very rapidly permeable in the substratum. The native vegetation was prairie grasses. Slope ranges from 0 to 2 percent.

Lawler soils are similar to Saude soils and commonly are adjacent to Hayfield, Marshan, Saude, and Waukee soils. Saude and Waukee soils are well drained. They are in the slightly higher lying areas. Their B horizon is browner than that of the Lawler soils. Hayfield soils are in positions on the landscape similar to those of the Lawler soils. Their A horizon is thinner and lighter colored than that of the Lawler soils. The poorly drained Marshan soils are on the lower lying parts of the landscape. Their B horizon is grayer than that of the Lawler soils.

Typical pedon of Lawler loam, 32 to 40 inches to sand and gravel, 0 to 2 percent slopes, 1,485 feet north and 330 feet west of the southeast corner of sec. 23, T. 90 N., R. 7 W.

Ap—0 to 8 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

A12—8 to 11 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; friable; slightly acid; gradual smooth boundary.

A3—11 to 16 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; some dark grayish brown (10YR 4/2) streaks in the lower part; weak fine granular structure; friable; discontinuous very dark brown (10YR 2/2) coatings on faces of peds; medium acid; gradual smooth boundary.

B1—16 to 21 inches; dark grayish brown (10YR 4/2) loam; few fine faint olive brown (2.5Y 4/4) mottles; weak fine subangular blocky structure; friable; discontinuous very dark brown (10YR 2/2) coatings on faces of peds; medium acid; gradual smooth boundary.

B2—21 to 30 inches; dark grayish brown (10YR 4/2) loam; few fine faint olive brown (2.5Y 4/4) and common fine distinct brown (10YR 4/3) mottles; weak medium and fine subangular blocky structure; friable; discontinuous very dark grayish brown (10YR 3/2) coatings in root channels; few fine pebbles; medium acid; gradual smooth boundary.

B31—30 to 34 inches; brown (10YR 4/3) sandy loam; weak medium and fine subangular blocky structure; very friable; discontinuous dark grayish brown (10YR 4/2) coatings on faces of peds; few fine pebbles; medium acid; gradual wavy boundary.

IIB32—34 to 38 inches; brown (10YR 5/3) gravelly loamy sand; common fine distinct brown (7.5YR 4/4) mottles; weak medium and fine subangular blocky structure; very friable; discontinuous brown

(10YR 4/3) coatings on faces of peds; slightly acid; gradual smooth boundary.

IIC1—38 to 45 inches; grayish brown (10YR 5/2) gravelly loamy sand; common fine distinct strong brown (7.5YR 5/8) mottles; single grain; loose; slightly acid; clear smooth boundary.

IIC2—45 to 50 inches; brown (10YR 5/3) gravelly loamy sand; common fine distinct grayish brown (10YR 5/2) and few fine faint dark yellowish brown (10YR 4/4) and yellowish brown (10YR 5/6) mottles; single grain; loose; slightly acid; clear smooth boundary.

IIC3—50 to 60 inches; brown (10YR 4/3) sand and fine gravel; single grain; loose; slightly acid.

The depth to a coarse textured layer ranges from 24 to 40 inches. Generally, the thickness of the solum also ranges from 24 to 40 inches.

The A horizon is loam or silt loam high in content of sand. The A1 horizon is black (10YR 2/1), very dark brown (10YR 2/2), or very dark gray (10YR 3/1). The A3 horizon is black (10YR 2/1), very dark gray (10YR 3/1), or very dark grayish brown (10YR 3/2). The thickness of the A horizon generally ranges from 12 to 18 inches, but in some pedons value is 2 or 3 to a depth of 24 inches. The B2 horizon typically is dark grayish brown (2.5Y or 10YR 4/2) and has high chroma mottles. It typically is loam but ranges to sandy clay loam. The IIB3 horizon and the upper part of the C horizon typically are gravelly loamy sand but range to gravelly sand.

Lilah series

The Lilah series consists of excessively drained, very rapidly permeable soils on uplands and alluvial benches. These soils formed in sandy loam about 12 to 28 inches deep over sandy material containing some gravel. The native vegetation was drought-tolerant grasses and trees. Slope ranges from 0 to 9 percent.

Lilah soils are similar to Finchford soils and commonly are adjacent to Burkhardt, Dickinson, Kenyon, and Sparta soils on uplands and to Finchford and Flagler soils on alluvial benches. Finchford soils contain more coarse sand and pebbles throughout the solum than the Lilah soils. The solum of Burkhardt soils is thinner than that of the Lilah soils. Dickinson soils are deeper to sand than the Lilah soils and do not contain pebbles. Kenyon soils formed in glacial till. Flagler soils are deeper to coarse sand and gravel than the Lilah soils. The solum of Sparta soils is more sandy throughout than that of the Lilah soils.

Typical pedon of Lilah sandy loam, 0 to 2 percent slopes, 1,310 feet west and 1,020 feet south of the center of sec. 10, T. 90 N., R. 9 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) sandy loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; strongly acid; abrupt smooth boundary.

A2—8 to 13 inches; brown (10YR 4/3) sandy loam, brown (10YR 5/3) dry; some very dark grayish brown (10YR 3/2) streaks; weak thick platy structure; friable; medium acid; clear smooth boundary.

B1t—13 to 17 inches; brown (7.5YR 4/4) sandy loam, weak fine subangular blocky structure; very friable; some clay bridging between sand grains; few stones 2 millimeters in size; strongly acid; clear smooth boundary.

B2t—17 to 21 inches; brown (7.5YR 4/4) sandy loam; weak coarse subangular blocky structure; very friable; some clay bridging between sand grains; strongly acid; clear wavy boundary.

B3—21 to 28 inches; strong brown (7.5YR 5/6) loamy sand; weak coarse subangular blocky structure; loose; few stones 2 millimeters in size; very strongly acid; clear smooth boundary.

C1—28 to 42 inches; yellowish brown (10YR 5/6) sand; single grain; loose; some fine pebbles; very strongly acid; clear smooth boundary.

C2—42 to 60 inches; light yellowish brown (10YR 6/4) sand; single grain; loose; few fine pebbles; few brown (7.5YR 4/4) wavy bands 1/4 to 1/2 inch thick; very strongly acid.

The thickness of the solum ranges from about 28 to 42 inches. The A1 or Ap horizon is very dark brown (10YR 2/2) or very dark grayish brown (10YR 3/2). It is 6 to 9 inches thick. The A horizon typically is sandy loam, but the range includes loam and gravelly sandy loam. The B horizon ranges from sandy loam to gravelly loamy sand or sand.

Marshan series

The Marshan series consists of poorly drained soils on alluvial benches. These soils formed in loamy alluvial material 24 to 40 inches deep over coarse textured alluvium. They are moderately permeable in the subsoil and rapidly permeable in the substratum. The native vegetation was prairie grasses and sedges or other water-tolerant plants. Slope ranges from 0 to 2 percent.

Marshan soils commonly are adjacent to Lawler and Hayfield soils. The adjacent soils are somewhat poorly drained and are in the slightly higher lying areas. Their B horizon is browner than that of the Marshan soils.

Typical pedon of Marshan clay loam, 32 to 40 inches to sand and gravel, 0 to 2 percent slopes, 1,300 feet south and 264 feet east of the center of sec. 3, T. 89 N., R. 10 W.

Ap—0 to 6 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

A12—6 to 16 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; neutral; clear smooth boundary.

A3—16 to 21 inches; black (10YR 2/1) clay loam, very dark gray (10YR 3/1) dry; few fine distinct olive gray (5Y 5/2) mottles; weak fine subangular blocky structure; friable; neutral; gradual smooth boundary.

B1g—21 to 26 inches; dark gray (5Y 4/1) clay loam; common fine prominent light olive brown (2.5Y 5/4) mottles; weak medium and fine subangular blocky structure; friable; neutral; gradual smooth boundary.

B21—26 to 30 inches; mottled dark grayish brown (2.5Y 4/2) and strong brown (7.5YR 5/6) loam; discontinuous grayish brown (2.5Y 5/2) coatings on faces of peds; weak medium and fine subangular blocky structure; friable; some black (10YR 2/1) filled pores; slightly acid; gradual smooth boundary.

B22—30 to 34 inches; mottled grayish brown (2.5Y 4/2) and strong brown (7.5YR 5/6) loam; discontinuous grayish brown (2.5Y 5/2) coatings on faces of peds; weak medium and fine subangular blocky structure; friable; some very dark gray (10YR 3/1) filled root channels and discontinuous coatings on faces of peds; slightly acid; gradual smooth boundary.

B3—34 to 39 inches; dark grayish brown (2.5Y 4/2) gravelly sandy loam; common fine distinct strong brown (7.5YR 5/6) and light olive brown (2.5Y 5/6) mottles; weak medium and fine subangular blocky structure; very friable; neutral; abrupt wavy boundary.

IIC—39 to 60 inches; yellowish brown (10YR 5/6) gravelly loamy sand; common fine distinct strong brown (7.5YR 5/6) mottles; single grain; loose; neutral.

The thickness of the solum ranges from 24 to 40 inches. The A horizon ranges from black (N 2/0) to very dark gray (10YR 3/1) and is 14 to 24 inches thick. It typically is clay loam, but the range includes loam and silty clay loam that is high in content of sand. The B2 horizon has hue of 5Y, 2.5Y, 7.5YR, or 10YR, value of 4 or 5, and chroma of 1 to 6. It is silty clay loam, clay loam, or loam. In some pedons the IIC horizon is loam or sandy loam in the upper part, but it is gravelly loamy sand or sand at a depth of 24 to 40 inches.

Maxfield series

The Maxfield series consists of poorly drained, moderately permeable soils on upland flats. These soils formed in 24 to 36 inches of loess and in the underlying glacial till. The native vegetation was prairie grasses and sedges or other water-tolerant plants. Slope ranges from 0 to 2 percent.

Maxfield soils commonly are adjacent to Dinsdale and Klinger soils. The well drained Dinsdale and somewhat poorly drained Klinger soils generally are more sloping than the Maxfield soils and are lower on the landscape. Also, their B horizon is more brown.

Typical pedon of Maxfield silty clay loam, 0 to 2 percent slopes, 1,122 feet north and 528 feet west of the southeast corner of sec. 35, T. 90 N., R. 10 W.

Ap—0 to 7 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

A12—7 to 14 inches; black (N 2/0) silty clay loam, very dark gray (N 3/0) dry; weak fine granular structure; friable; neutral; clear smooth boundary.

A3—14 to 18 inches; very dark gray (10YR 3/1) silty clay loam, dark gray (10YR 4/1) dry; few fine distinct olive gray (5Y 5/2) mottles; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

B1g—18 to 23 inches; dark gray (5Y 4/1) silty clay loam; common fine distinct grayish brown (2.5Y 5/2) and few fine distinct light olive brown (2.5Y 5/4) mottles; moderate medium and fine subangular blocky structure; friable; few fine dark oxides; neutral; clear smooth boundary.

B2t—23 to 30 inches; grayish brown (2.5Y 5/2) silt loam; common fine distinct light olive brown (2.5Y 5/6) mottles; moderate medium and fine subangular blocky structure; friable; some very dark gray (10YR 3/1) clay filled root channels; some fine dark oxides; neutral; clear wavy boundary.

IIB3t—30 to 38 inches; grayish brown (2.5Y 5/2) loam; common fine distinct yellowish brown (10YR 5/6) mottles; moderate medium and fine subangular blocky structure; firm; some very dark grayish brown (10YR 3/2) and dark grayish brown (10YR 4/2) clay filled root channels; a 1-inch lens of sand at 30 inches; neutral; gradual smooth boundary.

IIC—38 to 60 inches; mottled grayish brown (10YR 5/2) and yellowish brown (10YR 5/6) loam; common fine distinct strong brown (7.5YR 5/8) mottles; massive; firm; very dark gray (10YR 3/1) clay filled krotovinas at 39 to 40 inches; a 2-inch wedge of fine sand at 48 to 50 inches; neutral.

The solum ranges from about 36 to 55 inches in thickness. The loess is 24 to 36 inches thick.

The A horizon is black (N 2/0 or 10YR 2/1) and very dark gray (10YR 3/1 or 5Y 3/1). The B horizon has hue of 2.5Y or 5Y, value of 4 or 5, and chroma of 1 or 2. It is silt loam or silty clay loam. The IIB3 and IIC horizons typically are loam, but the range includes clay loam and sandy clay loam. A layer of loamy sand or sand, typically less than 10 inches thick, or a stone line separates the B horizon from the IIB horizon.

Nordness series

The Nordness series consists of well drained, moderately permeable soils on convex ridges and side slopes in the uplands. These soils formed in 8 to 20 inches of loamy material and, in most places, a thin,

discontinuous layer of clayey residuum underlain by limestone bedrock. The native vegetation was trees. Slope ranges from 2 to 30 percent.

Nordness soils are similar to Sogn soils and commonly are adjacent to Whalan soils. The dark A horizon of Sogn soils is thicker than that of the Nordness soils. Whalan soils are deeper to limestone bedrock than the Nordness soils. Their positions on the landscape are similar to those of the Nordness soils.

Typical pedon of Nordness loam, 14 to 30 percent slopes, 528 feet east and 600 feet north of the southwest corner of sec. 28, T. 90 N., R. 10 W.

A1—0 to 3 inches; black (10YR 2/1) loam, gray (10YR 5/1) and light gray (10YR 6/1) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

A2—3 to 5 inches; brown (10YR 5/3) loam, pale brown (10YR 6/3) dry; moderate thin platy structure; friable; continuous grayish brown (10YR 5/2) coatings on faces of peds, light brownish gray (10YR 6/2) dry; neutral; clear smooth boundary.

B21t—5 to 8 inches; yellowish brown (10YR 5/4) loam; weak fine subangular blocky structure; friable; few discontinuous clay films; medium acid; clear smooth boundary.

B22t—8 to 12 inches; dark yellowish brown (10YR 4/4) clay loam; moderate fine angular and subangular blocky structure; firm; few thin discontinuous clay films; medium acid; clear wavy boundary.

IIB3t—12 to 16 inches; brown (7.5YR 4/4) clay; moderate fine angular and subangular blocky structure; firm; thin nearly continuous clay films; dark yellowish brown (10YR 4/4) exteriors of peds that have very dark grayish brown (10YR 3/2) coatings in the lower part; neutral; abrupt wavy boundary.

IIR—16 inches; fractured limestone bedrock; hardness of rock increases to a depth of 19 inches.

The thickness of the solum generally is about 12 to 16 inches but ranges from 8 to 20 inches. The A1 horizon is black (10YR 2/1) or very dark gray (10YR 3/1). It is 1 to 4 inches thick. The A2 horizon is dark grayish brown (10YR 4/2) or brown (10YR 5/3). The A horizon typically is loam but in some pedons is silt loam. It typically formed in friable loamy material in the upper part and in residuum in the lower part. The residuum does not occur in some pedons. Hue ranges from 10YR in the B horizon to 5YR in the IIB3 horizon.

Olin series

The Olin series consists of well drained soils on uplands. These soils formed in 20 to 36 inches of eolian sandy loam and in the underlying glacial till. Permeability is moderately rapid in the upper sandy material and moderate in the underlying glacial till. The native vegetation was prairie grasses. Slope ranges from 2 to 9 percent.

Olin soils commonly are adjacent to Dickinson, Kenyon, and Sparta soils. They are in positions on the landscape similar to those of the adjacent soils. Dickinson and Sparta soils are deeper to glacial till than the Olin soils. Kenyon soils contain less sand in the upper part of the solum than the Olin soils.

Typical pedon of Olin fine sandy loam, 2 to 5 percent slopes, 725 feet south and 528 feet east of the northwest corner of sec. 30, T. 87 N., R. 10 W.

Ap—0 to 7 inches; very dark brown (10YR 2/2) fine sandy loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; very friable; neutral; abrupt smooth boundary.

A12—7 to 15 inches; very dark brown (10YR 2/2) fine sandy loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; very friable; neutral; clear smooth boundary.

A3—15 to 21 inches; very dark grayish brown (10YR 3/2) fine sandy loam, dark grayish brown (10YR 4/2) dry; few fine distinct brown (10YR 4/3) mottles; weak medium and fine subangular blocky structure; very friable; neutral; gradual smooth boundary.

B1—21 to 29 inches; brown (10YR 4/3) fine sandy loam; nearly continuous dark brown (10YR 3/3) coatings on faces of peds; weak fine subangular blocky structure; very friable; slightly acid; clear wavy boundary.

IIB21—29 to 35 inches; dark yellowish brown (10YR 4/4) loam; brown (10YR 5/3) on faces of peds; weak coarse prismatic structure parting to moderate fine subangular blocky; firm; discontinuous stone line at 29 inches; medium acid; clear smooth boundary.

IIB22—35 to 45 inches; yellowish brown (10YR 5/4) loam; light brownish gray (10YR 6/2) on faces of peds and prisms; few fine distinct grayish brown (10YR 5/2) and strong brown (7.5YR 5/8) mottles; moderate coarse prismatic structure parting to moderate medium angular and subangular blocky; firm; common very fine dark oxides; medium acid; clear smooth boundary.

IIB3—45 to 55 inches; yellowish brown (10YR 5/6) loam; grayish brown (10YR 5/2) on faces of prisms and in root channels; few fine distinct grayish brown (10YR 5/2) mottles; moderate coarse prismatic structure parting to moderate medium subangular blocky; firm; common very fine dark oxides; very dark grayish brown (10YR 3/2) coatings in some root channels; medium acid; clear smooth boundary.

IIC—55 to 60 inches; mottled yellowish brown (10YR 5/6) and grayish brown (10YR 5/2) loam; massive; firm; common very fine dark oxides; medium acid.

The thickness of the solum ranges from 40 to 60 inches. The depth to carbonates ranges from 50 to 80 inches.

The A horizon is 14 to 24 inches thick. The Ap horizon is very dark brown (10YR 2/2) or very dark grayish brown (10YR 3/2). The A1 horizon is black (10YR 2/1) or very dark brown (10YR 2/2). The B1 horizon is dark brown (10YR 3/3) or brown (10YR 4/3). It is dominantly fine sandy loam but in some pedons has layers of loamy sand 6 to 8 inches thick. The IIB horizon has hue of 10YR, value of 3 to 5, and chroma of 3 to 6. Below a depth of 30 inches, it has mottles with chroma of 2 or less. The mottles increase in size and abundance as depth increases. This horizon commonly is loam, but the range includes clay loam and sandy clay loam. The IIC horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 2 to 8.

Oran series

The Oran series consists of somewhat poorly drained, moderately permeable soils on broad ridges in the uplands. These soils formed in 14 to 24 inches of loamy sediments and in the underlying glacial till. The native vegetation was prairie grasses and trees. Slope ranges from 1 to 3 percent.

Oran soils are similar to Readlyn soils and commonly are adjacent to Bassett, Kenyon, Readlyn, and Tripoli soils. Readlyn soils are in positions on the landscape similar to those of the Oran soils. Their A horizon is thicker and darker than that of the Oran soils. Bassett and Kenyon soils are moderately well drained. They generally are more sloping than the Oran soils and are lower on the landscape. Also, the upper part of their B horizon is browner. The poorly drained Tripoli soils generally are less sloping than the Oran soils and are higher on the landscape. Also, the upper part of their B horizon is grayer.

Typical pedon of Oran loam, 1 to 3 percent slopes, 1,685 feet north and 960 feet east of the center of sec. 8, T. 89 N., R. 9 W.

A1—0 to 7 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; weak fine granular structure; friable; neutral; clear smooth boundary.

A2—7 to 10 inches; dark grayish brown (10YR 4/2) loam, grayish brown (10YR 5/2) dry; weak thin platy structure parting to weak fine granular; friable; nearly continuous very dark grayish brown (10YR 3/2) coatings; neutral; clear smooth boundary.

B1—10 to 16 inches; brown (10YR 4/3) loam; common fine distinct dark grayish brown (10YR 4/2) mottles; weak fine subangular blocky structure; friable; discontinuous dark grayish brown (10YR 4/2) coatings on faces of peds and in pores; slightly acid; clear wavy boundary.

IIB21t—16 to 25 inches; grayish brown (10YR 5/2) loam; common very fine distinct reddish brown (5YR 5/4) mottles; moderate fine subangular blocky structure; firm; very dark gray (10YR 3/1) clay filled root channels; thin discontinuous clay films; discontinuous light brownish gray (10YR 6/2) sand and silt coatings on faces of peds when dry; medium acid; clear smooth boundary.

IIB22t—25 to 39 inches; mottled strong brown (7.5YR 5/6) and light brownish gray (10YR 6/2) loam; weak coarse prismatic structure parting to moderate medium angular and subangular blocky; firm; thin discontinuous light brownish gray (10YR 6/2) sand and silt coatings on faces of peds when dry; discontinuous clay films on faces of peds; some clay filled root channels; few fine dark oxides; medium acid; gradual smooth boundary.

IIB3t—39 to 56 inches; strong brown (7.5YR 5/6) loam; common medium and fine distinct light brownish gray (10YR 6/2) and grayish brown (10YR 5/2) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; few fine dark oxides; discontinuous grayish brown (10YR 5/2) sand and silt coatings on faces of peds when dry; some very dark grayish brown (10YR 3/2) clay filled root channels; strongly acid; gradual smooth boundary.

IIC—56 to 60 inches; strong brown (7.5YR 5/6) loam; common medium and fine distinct light brownish gray (10YR 6/2) mottles; massive; firm; common dark oxides; mildly alkaline.

The thickness of the solum ranges from 40 to 60 inches. The A1 or Ap horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). The A2 horizon is 3 to 6 inches thick. The A horizon is loam or silt loam. The depth to a stone line or to the IIB horizon ranges from 14 to 24 inches. The B and IIB horizons are loam, clay loam, or sandy clay loam. They have hue of 10YR, 2.5Y, or 7.5YR. The B horizon and the upper part of the IIB horizon have value of 4 or 5 and chroma of 2 or 3 and have higher chroma mottles. The lower part of the IIB horizon have value of 4 to 6 and chroma of 2 to 6. The IIB horizon is medium acid or strongly acid.

Palms series

The Palms series consists of very poorly drained organic soils in depressions on uplands and alluvial benches. These soils formed in sapric material 18 to 52 inches deep over glacial till or alluvial sediments. Permeability is moderately slow to moderately rapid in the sapric material and moderately slow or moderate in the underlying mineral material. The native vegetation was grasses and sedges or other water-tolerant plants. Slope ranges from 1 to 4 percent.

Palms soils commonly are adjacent to Clyde, Marshan, and Maxfield soils. The adjacent soils do not have a surface layer of decomposed organic material more than 18 inches thick. They are higher on the landscape than the Palms soils.

Typical pedon of Palms muck, 1 to 4 percent slopes, 2,080 feet west and 265 feet north of the center of sec. 2, T. 90 N., R. 10 W.

Oa1—0 to 10 inches; black (N 2/0), broken face and rubbed, sapric material; about 15 percent fiber, less than 5 percent rubbed; weak medium subangular blocky structure; slightly sticky; herbaceous fibers; neutral; abrupt smooth boundary.

Oa2—10 to 28 inches; black (N 2/0), broken face and rubbed, sapric material; about 10 percent fiber, less than 5 percent rubbed; weak coarse subangular blocky structure; slightly sticky; herbaceous fibers; neutral; gradual smooth boundary.

Oa3—28 to 45 inches; black (N 2/0), broken face, very dark brown (10YR 2/2), rubbed, sapric material; about 15 percent fiber, less than 5 percent rubbed; weak coarse subangular blocky structure; slightly sticky; herbaceous fibers; neutral; gradual smooth boundary.

IIC—45 to 60 inches; black (10YR 2/1) mucky silt loam; massive; friable; few medium and coarse sand grains; neutral.

The sapric material ranges from 18 to 52 inches in thickness. It is derived from herbaceous plants and generally is free of twigs and branches. It is black (N 2/0 or 10YR 2/1) or very dark brown (10YR 2/2). The IIC horizon typically is silty clay loam, loam, or mucky silt loam that has sandy strata in some pedons. It typically is neutral but ranges from slightly acid to mildly alkaline. It typically is black (10YR 2/1), but the range includes gray (5Y 5/1), olive gray (5Y 5/2), light olive gray (5Y 6/2), and greenish gray (5G 6/1).

Protivin series

The Protivin series consists of somewhat poorly drained soils on slightly concave side slopes in the uplands. These soils formed in 14 to 24 inches of loamy sediments and in the underlying glacial till. Permeability is moderate in the loamy sediments and moderately slow in the underlying glacial till. The native vegetation was prairie grasses. Slope ranges from 1 to 4 percent.

Protivin soils commonly are adjacent to Clyde, Donnan, Floyd, and Kenyon soils. They are in positions on the landscape similar to those of the adjacent soils. Clyde soils are poorly drained. Their subsoil is grayer than that of the Protivin soils. Clyde and Floyd soils contain less clay than the Protivin soils and are more stratified in the upper part. Donnan soils contain more clay in the subsoil than the Protivin soils. Also, they have a thinner A horizon. Kenyon soils are moderately well drained. Their subsoil is browner than that of the Protivin soils.

Typical pedon of Protivin loam, 1 to 4 percent slopes, 610 feet east and 528 feet south the northwest corner of sec. 24, T. 89 N., R. 7 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; medium acid; abrupt smooth boundary.

A12—8 to 11 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; medium acid; clear smooth boundary.

A3—11 to 14 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable; medium acid; gradual smooth boundary.

B1—14 to 20 inches; dark grayish brown (10YR 4/2) loam; common fine distinct yellowish brown (10YR 5/4) mottles; weak medium subangular blocky structure; firm; discontinuous very dark grayish brown (10YR 3/2) coatings on faces of peds; few dark oxides; medium acid; gradual smooth boundary.

IIB21t—20 to 28 inches; mottled yellowish brown (10YR 5/6) and dark grayish brown (2.5Y 4/2) clay loam; weak coarse prismatic structure parting to moderate medium subangular blocky; very firm; thin discontinuous clay films on faces of peds; stone line at 20 inches; very few dark oxides; medium acid; gradual smooth boundary.

IIB22t—28 to 35 inches; mottled strong brown (7.5YR 5/6) and dark grayish brown (10YR 4/2) clay loam; moderate coarse prismatic structure parting to moderate medium subangular blocky; very firm; thin discontinuous clay films on faces of peds; nearly continuous grayish brown (2.5Y 5/2) coatings on faces of prisms; neutral; gradual smooth boundary.

IIB3—35 to 51 inches; mottled grayish brown (2.5Y 5/2) and strong brown (7.5YR 5/6) clay loam; moderate coarse prismatic structure; very firm; neutral; abrupt smooth boundary.

IIC—51 to 60 inches; mottled grayish brown (2.5Y 5/2) and yellowish brown (10YR 5/6) clay loam; massive; very firm; few lime concretions; slight effervescence; mildly alkaline.

The solum ranges from 38 to 68 inches in thickness. The A and B horizons are medium acid or strongly acid unless limed. The A3 horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2). The A horizon is 12 to 18 inches thick. It typically is loam, but the range includes silt loam and clay loam. The IIB horizon has hue of 10YR, 2.5Y, or 7.5YR, value of 4 or 5, and chroma of 2 to 6. It ranges from medium acid to mildly alkaline. The IIC horizon is clay loam or loam.

Readlyn series

The Readlyn series consists of somewhat poorly drained, moderately permeable soils on broad ridges and slightly convex side slopes in the uplands. These soils formed in 14 to 24 inches of loamy sediments and in the underlying glacial till. The native vegetation was prairie grasses. Slope ranges from 1 to 3 percent.

Readlyn soils are similar to Oran soils and commonly are adjacent to Kenyon, Oran, and Tripoli soils. Oran soils are in positions on the landscape similar to those of the Readlyn soils. Their A horizon is thinner than that of the Readlyn soils. Kenyon soils are moderately well drained. They generally are more sloping than the Readlyn soils and are lower on the landscape. Also, the upper part of their B horizon is browner. Tripoli soils are poorly drained. They generally are less sloping than the Readlyn soils and are higher on the landscape. Also, the upper part of their B horizon is grayer.

Typical pedon of Readlyn loam, 1 to 3 percent slopes, 1,220 feet south and 250 feet west of the northeast corner of sec. 28, T. 88 N., R. 10 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

A12—8 to 13 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; friable; neutral; clear smooth boundary.

A3—13 to 17 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; weak fine subangular blocky structure; friable; medium acid; clear smooth boundary.

B1—17 to 22 inches; dark grayish brown (10YR 4/2) loam; nearly continuous very dark grayish brown (10YR 3/2) coatings on faces of peds; few fine distinct light olive brown (2.5Y 5/4) mottles; weak fine subangular blocky structure; friable; stone line at 22 inches; medium acid; clear wavy boundary.

IIB21—22 to 30 inches; olive brown (2.5Y 4/4) loam; nearly continuous dark grayish brown (10YR 4/2) coatings on faces of peds; few fine distinct light olive brown (2.5Y 5/6) and brown (7.5YR 4/4) mottles; moderate medium prismatic structure parting to moderate medium and fine subangular blocky; firm; few fine dark oxides; medium acid; gradual smooth boundary.

IIB22—30 to 38 inches; light olive brown (2.5Y 5/4) loam; nearly continuous dark gray (10YR 4/1) coatings on faces of prisms; nearly continuous dark grayish brown (10YR 4/2) coatings on faces of peds; few fine distinct brown (7.5YR 4/4) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; few dark oxides; slightly acid; gradual smooth boundary.

IIB3—38 to 50 inches; light olive brown (2.5Y 5/6) loam; nearly continuous grayish brown (10YR 5/2) coatings on faces of prisms; few fine distinct grayish brown (10YR 5/2) and common fine distinct brown (7.5YR 4/4) mottles; weak coarse prismatic structure parting to moderate medium and fine subangular and angular blocky; firm; few fine dark oxides; slightly acid; gradual smooth boundary.

IIC1—50 to 55 inches; light olive brown (2.5Y 5/6) loam; few fine distinct grayish brown (10YR 5/2) and brown (7.5YR 4/2) mottles; weak coarse prismatic structure; firm; few fine dark oxides; strong effervescence; mildly alkaline; gradual smooth boundary.

IIC2—55 to 60 inches; light olive brown (2.5Y 5/6) loam; few fine distinct grayish brown (10YR 5/2) and common fine distinct brown (7.5YR 4/4) mottles; massive; firm; common dark oxides; strong effervescence; mildly alkaline.

The thickness of the solum ranges from 40 to 60 inches. The A horizon is black (10YR 2/1) or very dark brown (10YR 2/2) in the upper part and very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2) in the lower part. It is about 15 to 20 inches thick. It typically is loam, but the range includes silty clay loam and silt loam high in content of sand. The B horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 to 8. The IIB and IIC horizons are loam, clay loam, or sandy clay loam.

Rockton series

The Rockton series consists of well drained, moderately permeable soils on convex ridges and side slopes in the uplands. These soils formed in loamy material 20 to 40 inches deep over limestone bedrock. The native vegetation was mixed prairie grasses. Slope ranges from 0 to 6 percent.

Rockton soils are similar to Sogn soils and commonly are adjacent to Kenyon and Sogn soils. Sogn soils are more shallow to limestone bedrock than the Rockton soils. They are in the more sloping areas downslope from the Rockton soils. Kenyon soils formed in glacial till. They are upslope from the Rockton soils.

Typical pedon of Rockton loam, 30 to 40 inches to limestone, 2 to 6 percent slopes, 890 feet north and 890 feet east of the southwest corner of sec. 33, T. 87 N., R. 10 W.

Ap—0 to 7 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; slightly acid; abrupt smooth boundary.

A12—7 to 10 inches; very dark gray (10YR 3/1) loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; slightly acid; clear smooth boundary.

A3—10 to 18 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; some dark brown (10YR 3/3) streaks; weak fine granular structure; friable; slightly acid; clear smooth boundary.

B1—18 to 26 inches; brown (10YR 4/3) loam; nearly continuous very dark grayish brown (10YR 3/2) coatings on faces of peds; moderate fine subangular

blocky structure; friable; slightly acid; gradual smooth boundary.

B2—26 to 34 inches; dark yellowish brown (10YR 4/4) loam; discontinuous brown (10YR 4/3) coatings on faces of peds; few fine distinct very dark grayish brown (10YR 3/2) mottles; moderate medium and fine subangular blocky structure; friable; slightly acid; abrupt wavy boundary.

IIR—34 inches; fractured limestone bedrock; some grayish brown (10YR 5/2) rinds of residuum on limestone particles in the upper part.

The thickness of the solum, or the depth to limestone bedrock, ranges from 20 to 40 inches. The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is 10 to 18 inches thick. It typically is loam, but the range includes silt loam. The B horizon has value of 4 or 5 and chroma of 3 to 6. It has hue of 10YR in the upper part and 10YR or 7.5YR in the lower part. In some pedons residuum is not evident or is evident only as rinds around flagstones. In other pedons, however, it is as much as 6 inches of clay loam, clay, or silty clay.

Saude series

The Saude series consists of well drained soils on alluvial benches and uplands. These soils formed in 24 to 32 inches of loamy alluvial material and in the underlying coarse textured alluvium. They are moderately permeable in the upper part and very rapidly permeable in the substratum. The native vegetation was prairie grasses. Slope ranges from 0 to 5 percent.

Saude soils are similar to Wapsie soils and commonly are adjacent to Flagler and Wapsie soils. They are in positions on the landscape similar to those of the adjacent soils. The A horizon of Wapsie soils is thinner and lighter colored than that of the Saude soils. Flagler soils contain more sand in the upper part of the solum than the Saude soils.

Typical pedon of Saude loam, 0 to 2 percent slopes, 2,310 feet east and 130 feet south of the northwest corner of sec. 28, T. 89 N., R. 9 W.

Ap—0 to 7 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

A12—7 to 16 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; friable; neutral; clear smooth boundary.

B1—16 to 22 inches; brown (10YR 4/3) loam; nearly continuous very dark grayish brown (10YR 3/2) coatings on faces of peds; weak fine subangular blocky structure; friable; few fine pebbles; medium acid; gradual smooth boundary.

B2—22 to 28 inches; brown (10YR 4/3) loam; weak medium subangular blocky structure; friable; less than 3 percent very fine gravel and coarse sand; medium acid; clear wavy boundary.

IIB3—28 to 34 inches; dark yellowish brown (10YR 4/4) gravelly loamy sand; weak medium subangular blocky structure; very friable; medium acid; gradual smooth boundary.

IIC—34 to 60 inches; yellowish brown (10YR 5/4) gravelly sand; single grain; loose; medium acid.

The solum generally is 24 to 44 inches thick but ranges from 18 to 54 inches in thickness. In uneroded areas the A horizon is black (10YR 2/1) or very dark brown (10YR 2/2). It is 11 to 16 inches thick. The B horizon has hue of 10YR, value of 4 or 5, and chroma of 3 to 6. The content of clay in this horizon ranges from 12 to 20 percent. The B and IIB horizons are slightly acid or medium acid. The depth to gravelly loamy sand, gravelly sand, or sand dominantly is 24 to 32 inches but ranges from 18 to 36 inches. The C horizon is loamy sand or gravelly sand. The content of gravel in this horizon, by volume, is 5 to 15 percent. Carbonates are leached to a depth of 72 inches or more.

Schley series

The Schley series consists of somewhat poorly drained, moderately permeable soils on foot slopes and in coves on uplands. These soils formed in about 36 inches of loamy sediments and in the underlying firm glacial till. The native vegetation was prairie grasses and trees. Slope ranges from 1 to 4 percent.

Schley soils are similar to Clyde and Floyd soils and commonly are adjacent to Clyde, Floyd, and Oran soils. Clyde and Floyd soils are less acid throughout the solum than the Schley soils. Also, their dark A horizon is thicker. Clyde soils are along drainageways and are lower on the landscape than the Schley soils. Floyd soils are in positions on the landscape similar to those of the Schley soils. Oran soils are on ridges and are higher on the landscape than the Schley soils. Also, the subsoil is less stratified.

Typical pedon of Schley loam, 1 to 4 percent slopes, 1,550 feet east and 495 feet south of the northwest corner of sec. 8, T. 89 N., R. 9 W.

A1—0 to 7 inches; very dark gray (10YR 3/1) loam, gray (10YR 5/1) dry; weak fine granular structure; friable; slightly acid; clear smooth boundary.

A2—7 to 13 inches; dark grayish brown (10YR 4/2) loam, grayish brown (10YR 5/2) dry; some very dark grayish brown (10YR 3/2) streaks; weak medium platy structure parting to weak fine granular; friable; nearly continuous very dark grayish brown (10YR 3/2) coatings on faces of peds; slightly acid; clear smooth boundary.

B21—13 to 20 inches; brown (10YR 4/3) loam; few fine distinct dark grayish brown (10YR 4/2) mottles; weak fine subangular blocky structure; friable;

discontinuous very dark grayish brown (10YR 3/2) coatings on faces of peds in the upper part and discontinuous dark grayish brown (10YR 4/2) coatings on faces of peds in the lower part; strongly acid; gradual smooth boundary.

B22—20 to 34 inches; brown (10YR 5/3) loam; common fine distinct grayish brown (10YR 5/2) and strong brown (7.5YR 5/6) mottles; moderate medium and fine subangular blocky structure; friable; few fine dark oxides; discontinuous dark grayish brown (10YR 4/2) coatings on faces of peds; stone line at 34 inches; strongly acid; abrupt wavy boundary.

IIB3t—34 to 45 inches; yellowish brown (10YR 5/6) loam; common fine distinct grayish brown (10YR 5/2) mottles; moderate coarse prismatic structure parting to moderate medium subangular blocky; firm; some dark gray (10YR 4/1) stains on faces of prisms; discontinuous dark grayish brown (10YR 4/2) clay films and clay filled pores; discontinuous light brownish gray (10YR 6/2) sand and silt coatings on faces of prisms; few dark oxides; strongly acid; gradual smooth boundary.

IIC—45 to 60 inches; brown (7.5YR 4/4) loam; common medium and fine distinct grayish brown (10YR 5/2) mottles; massive; firm; common dark oxides; strongly acid.

The thickness of the solum ranges from 40 to 60 inches. The A1 or Ap horizon is black (10YR 2/1), very dark gray (10YR 3/1), very dark brown (10YR 2/2), or very dark grayish brown (10YR 3/2). It is 6 to 10 inches thick. The A2 horizon is dark grayish brown (10YR 4/2) or grayish brown (10YR 5/2). It is 6 to 10 inches thick. The B and IIB horizons range from medium acid to very strongly acid. The B2 horizon is loam, silt loam high in content of sand, or clay loam and commonly has strata of sandy loam. The IIB3t horizon ranges from loam to clay loam and in some pedons has lenses of sandy loam or pockets of sand or gravel. It has hue of 7.5YR or 10YR, value of 4 to 6, and chroma of 4 to 8. It has few to many mottles that have hue of 2.5Y or 10YR, value of 4 to 6, and chroma of 2.

Schley Variant

The Schley Variant consists of somewhat poorly drained soils on uplands. These soils formed in loamy and sandy sediments and in the underlying firm glacial till. Permeability is rapid in the loamy sediments and moderate in the underlying glacial till. The native vegetation was prairie grasses, water-tolerant plants, and trees. Slope ranges from 1 to 4 percent.

Schley Variant soils commonly are adjacent to Chelsea, Lamont, and Sparta soils. The adjacent soils are on convex slopes and are higher on the landscape and better drained than the Schley Variant soils. Also, their B horizon is browner.

Typical pedon of Schley Variant sandy loam, 1 to 4 percent slopes, 1,750 feet east and 265 feet north of the center of sec. 32, T. 90 N., R. 9 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) sandy loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

B21t—8 to 17 inches; brown (10YR 4/3) sandy loam; common medium and fine distinct grayish brown (10YR 5/2) and common fine distinct brown (7.5YR 4/4) mottles; weak fine subangular blocky structure; friable; some clay bridging between sand grains in the lower part; medium acid; clear smooth boundary.

B22t—17 to 27 inches; mottled grayish brown (10YR 5/2), dark yellowish brown (10YR 4/4), and brown (7.5YR 4/4) sandy loam; weak fine subangular blocky structure; friable; some clay bridging between sand grains; strongly acid; gradual smooth boundary.

B3—27 to 37 inches; mottled light brownish gray (10YR 6/2) and brown (7.5YR 4/4) loamy sand; weak coarse subangular blocky structure; very friable; few fine dark oxides; strongly acid; gradual smooth boundary.

C1—37 to 50 inches; brown (10YR 5/3) fine sand; few medium distinct grayish brown (10YR 5/2) mottles; very thin brown (7.5YR 4/4) streaks; single grain; loose; medium acid; abrupt wavy boundary.

IIC2—50 to 60 inches; yellowish brown (10YR 5/4) loam; common fine distinct light brownish gray (2.5Y 6/2) mottles; very thin brown (7.5YR 4/4) streaks; massive; firm; many dark oxides between 50 and 52 inches; medium acid.

The thickness of the solum ranges from 30 to 50 inches. The depth to loamy sand or sand ranges from 24 to 40 inches. The depth to glacial till is 50 to 60 inches.

The A horizon is very dark brown (10YR 2/2), very dark grayish brown (10YR 3/2), black (10YR 2/1), or very dark gray (10YR 3/1). It is 6 to 9 inches thick. The B horizon is medium acid or strongly acid. The B2 horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 to 4. The B3 horizon has hue of 10YR or 7.5YR, value of 4 to 6, and chroma of 2 to 4. It typically is loamy sand, but the range includes sandy loam and sandy clay loam. The C horizon has colors similar to those in the lower part of the B horizon. It is loamy sand or fine sand. The IIC horizon ranges from loam to clay loam.

Seaton series

The Seaton series consists of well drained, moderately permeable soils on convex ridges and side slopes in the uplands. These soils formed in loess. The native vegetation was hardwood trees. Slope ranges from 2 to 30 percent.

Seaton soils commonly are adjacent to Chelsea and Lamont soils. The adjacent soils are in positions on the landscape similar to those of the Seaton soils. They contain more sand and less silt than the Seaton soils.

Typical pedon of Seaton silt loam, 2 to 5 percent slopes, 1,450 feet south and 1,155 feet east of the northwest corner of sec. 28, T. 88 N., R. 8 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, light brownish gray (10YR 6/2) dry; weak fine granular structure; friable; slightly acid; clear smooth boundary.

B1—6 to 12 inches; dark yellowish brown (10YR 4/4) silt loam; weak fine subangular blocky structure; friable; discontinuous grayish brown silt and sand coatings on faces of peds when dry; strongly acid; gradual smooth boundary.

B21t—12 to 18 inches; dark yellowish brown (10YR 4/4) silt loam; nearly continuous brown (10YR 4/3 and 7.5YR 4/4) coatings on faces of peds; weak fine subangular blocky structure; friable; thin discontinuous clay films on faces of peds; some clay filled root channels; discontinuous grayish brown (10YR 5/2) silt and sand coatings on faces of peds when dry; strongly acid; gradual smooth boundary.

B22t—18 to 30 inches; dark yellowish brown (10YR 4/4) silt loam; nearly continuous brown (10YR 4/3) coatings on faces of peds; few medium distinct strong brown (7.5YR 5/6) mottles; few fine distinct red (2.5YR 4/6) mottles in the upper part; moderate fine angular blocky structure; friable; nearly continuous thick grayish brown (10YR 5/2) silt and sand coatings on faces of peds when dry; thin discontinuous clay films on faces of peds; strongly acid; gradual smooth boundary.

B31t—30 to 44 inches; dark yellowish brown (10YR 4/4) silt loam; nearly continuous brown (7.5YR 4/4) coatings on faces of peds; few fine distinct brownish yellow (10YR 6/6) mottles; moderate medium and fine subangular blocky structure; thick discontinuous grayish brown (10YR 5/2) silt and sand coatings on faces of peds when dry; thin discontinuous clay films on faces of peds and in root channels; strongly acid; gradual smooth boundary.

B32—44 to 56 inches; yellowish brown (10YR 5/6) silt loam; nearly continuous brown (10YR 4/3) coatings on faces of peds; few very fine faint grayish brown (10YR 5/2) mottles; weak medium and fine subangular blocky structure; friable; discontinuous thin grayish brown (10YR 5/2) silt and sand coatings on faces of peds when dry; strongly acid; gradual smooth boundary.

C—56 to 60 inches; dark yellowish brown (10YR 4/4) silt loam; few fine distinct brown (7.5YR 4/4) and strong brown (7.5YR 5/6) and few fine faint brown (10YR 5/3) mottles; massive; friable; strongly acid.

The thickness of the solum ranges from 42 to more than 70 inches. In uneroded areas the A1 horizon is very dark grayish brown (10YR 3/2) or dark brown (10YR 3/3). It is 2 to 5 inches thick. In cultivated areas the Ap horizon is dark grayish brown (10YR 4/2) or brown (10YR 4/3 or 5/3). Some pedons have an A2 horizon. This horizon is dark grayish brown (10YR 4/2), grayish brown (10YR 5/2), or brown (10YR 4/3 or 5/3). It is 3 to 5 inches thick. The B horizon is medium acid or strongly acid. It has hue of 10YR, value of 4 or 5, and chroma of 3 to 6. The content of clay in the B2 horizon ranges from 18 to 26 percent. The color of the C horizon is similar to that of the B horizon, but in some pedons the mottles have chroma of 2 to 6.

Sogn series

The Sogn series consists of somewhat excessively drained, moderately permeable soils on convex ridges and side slopes in the uplands. These soils formed in loamy material 4 to 20 inches deep over limestone bedrock. The native vegetation was drought-tolerant prairie grasses. Slope ranges from 2 to 9 percent.

These soils receive more moisture than is defined as the range for the Sogn series. This difference, however, does not alter the use or behavior of the soils.

Sogn soils are similar to Nordness soils and commonly are adjacent to Bertram and Rockton soils. The A horizon of Nordness soils is thinner than that of the Sogn soils. Bertram and Rockton soils are deeper to bedrock than the Sogn soils. Also, they are higher on the landscape.

Typical pedon of Sogn loam, 2 to 9 percent slopes, 1,450 feet north and 495 feet east of the southwest corner of sec. 33, T. 87 N., R. 10 W.

Ap—0 to 7 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; weak fine granular structure; friable; neutral; clear smooth boundary.

A12—7 to 18 inches; very dark grayish brown (10YR 3/2) loam, dark grayish brown (10YR 4/2) dry; common fine distinct dark brown (10YR 3/3) mottles; weak medium subangular blocky structure parting to weak fine granular; friable; neutral; abrupt wavy boundary.

R—18 inches; fractured limestone bedrock.

The thickness of the solum, or the depth to limestone bedrock, ranges from 4 to 20 inches. The A horizon is very dark brown (10YR 2/2), very dark gray (10YR 3/1), very dark grayish brown (10YR 3/2), or dark brown (10YR 3/3). It is loam, silt loam high in content of sand, sandy loam, or clay loam. In some pedons 1 to 4 inches of clay or silty clay is directly above the limestone bedrock.

Sparta series

The Sparta series consists of excessively drained soils on uplands and alluvial benches. These soils formed in sandy material deposited dominantly by wind but, in some areas, by water. Permeability is moderately rapid in the upper part and rapid in the lower part. The native vegetation was drought-tolerant prairie grasses. Slope ranges from 0 to 9 percent.

Sparta soils commonly are adjacent to Chelsea, Dickinson, Finchford, and Lamont soils. They are in positions on the landscape similar to those of the adjacent soils. Chelsea soils are dark to a lesser depth than the Sparta soils and have a lighter colored A horizon. Dickinson and Lamont soils contain less sand in the upper part of the solum than the Sparta soils. Finchford soils contain coarser sand than the Sparta soils and have pebbles throughout.

Typical pedon of Sparta loamy fine sand, 2 to 5 percent slopes, 275 feet west and 610 feet north of the southeast corner of sec. 28, T. 88 N., R. 10 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) loamy fine sand, dark grayish brown (10YR 4/2) dry; weak fine granular structure; very friable; neutral; abrupt smooth boundary.

A12—7 to 20 inches; very dark grayish brown (10YR 3/2) loamy fine sand, dark grayish brown (10YR 4/2) dry; weak medium angular blocky structure parting to weak fine granular; very friable; neutral; clear smooth boundary.

A3—20 to 24 inches; dark brown (10YR 3/3) loamy fine sand, brown (10YR 4/3) dry; weak medium subangular blocky structure; very friable; medium acid; clear smooth boundary.

B2—24 to 36 inches; brown (10YR 4/3) loamy fine sand; nearly continuous very dark grayish brown (10YR 3/2) coatings on faces of peds; weak medium subangular blocky structure; very friable; medium acid; clear smooth boundary.

B3—36 to 40 inches; yellowish brown (10YR 5/4) loamy fine sand; discontinuous brown (10YR 4/3) coatings on faces of peds; weak medium subangular blocky structure; very friable; medium acid; abrupt wavy boundary.

C—40 to 60 inches; yellowish brown (10YR 5/4) sand; single grain; loose; medium acid.

The thickness of the solum ranges from 24 to about 40 inches. The A horizon ranges from loamy fine sand or loamy sand to fine sand. The B horizon has hue of 10YR and value and chroma of 3 to 6. It is fine sand, loamy sand, or loamy fine sand.

Spillville series

The Spillville series consists of moderately well drained or somewhat poorly drained, moderately permeable soils on flood plains. These soils formed in loamy alluvium. The native vegetation was prairie grasses. Slope ranges from 0 to 2 percent.

Spillville soils commonly are adjacent to Coland, Lawler, and Waukee soils. Coland soils are in positions on the landscape similar to those of the Spillville soils. Their solum contains more clay than that of the Spillville soils, and their substratum is grayer. Lawler and Waukee soils are shallower to coarse textured material than the Spillville soils. Also, they are higher on the landscape.

Typical pedon of Spillville loam, 0 to 2 percent slopes, 1,056 feet west and 132 feet north of the southeast corner of sec. 27, T. 88 N., R. 8 W.

Ap—0 to 7 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; moderate fine granular structure; friable; neutral; abrupt smooth boundary.

A12—7 to 12 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak coarse subangular blocky structure parting to weak fine subangular blocky; friable; neutral; clear smooth boundary.

A13—12 to 22 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; moderate very fine subangular blocky structure; friable; slightly acid; gradual smooth boundary.

A14—22 to 30 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; weak coarse prismatic structure parting to moderate fine subangular blocky; friable; slightly acid; gradual smooth boundary.

A15—30 to 40 inches; dark brown (10YR 3/3) loam, brown (10YR 4/3) dry; weak medium subangular blocky structure; friable; discontinuous very dark gray (10YR 3/2) coatings on faces of peds; slightly acid; clear smooth boundary.

C1—40 to 50 inches; brown (10YR 4/3) sandy loam; few fine faint dark grayish brown (10YR 4/2) mottles; massive; very friable; slightly acid; abrupt smooth boundary.

C2—50 to 60 inches; yellowish brown (10YR 5/4) loamy sand; few fine faint grayish brown (10YR 5/2) and brown (10YR 5/3) mottles; single grain; loose; about 5 percent fine gravel; slightly acid.

The solum ranges from 30 to 56 inches in thickness. It commonly is neutral or slightly acid. The A horizon typically is loam but in some pedons is silt loam high in content of sand. It typically is black (10YR 2/1) or very dark brown (10YR 2/2) but in some pedons is very dark gray (10YR 3/1), very dark grayish brown (10YR 3/2), or dark brown (10YR 3/3). The dark colors extend to a depth of 30 inches or more. Some pedons have a B horizon. The B and C horizons have hue of 10YR or 2.5Y. They are sandy loam or, below a depth of 40 inches, loam and loamy sand.

Tripoli series

The Tripoli series consists of poorly drained, moderately permeable soils on upland flats. These soils formed in 18 to 28 inches of loamy sediments and in the underlying glacial till. The native vegetation was prairie grasses and water-tolerant plants. Slope ranges from 0 to 2 percent.

Tripoli soils are similar to Clyde soils and commonly are adjacent to Clyde, Kenyon, Oran, and Readlyn soils. Clyde soils are deeper to firm glacial till and to carbonates than the Tripoli soils. They are in drainageways on the lower parts of the landscape. The moderately well drained Kenyon and somewhat poorly drained Oran and Readlyn soils generally are more sloping than the Tripoli soils and are lower on the landscape. Also, their B horizon is browner.

Typical pedon of Tripoli clay loam, 0 to 2 percent slopes, 2,245 feet south and 130 feet west of the northeast corner of sec. 28, T. 88 N., R. 10 W.

Ap—0 to 8 inches; black (N 2/0) clay loam, very dark gray (N 3/0) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

A12—8 to 14 inches; black (N 2/0) clay loam, very dark gray (N 3/0) dry; moderate fine granular structure; friable; neutral; clear smooth boundary.

A3—14 to 19 inches; black (10YR 2/1) clay loam, very dark gray (N 3/1) dry; few fine distinct dark grayish brown (2.5Y 4/2) mottles; weak fine subangular blocky structure; friable; neutral; clear smooth boundary.

B1g—19 to 25 inches; dark grayish brown (2.5Y 4/2) loam; nearly continuous very dark gray (10YR 3/1) coatings on faces of peds; common fine distinct light olive brown (2.5Y 5/4) and few fine distinct dark gray (10YR 4/1) mottles; moderate fine subangular blocky structure; friable; few fine dark oxides; mildly alkaline; abrupt smooth boundary.

IIB2—25 to 35 inches; light olive brown (2.5Y 5/4) loam; discontinuous dark gray (10YR 4/1) coatings on faces of peds; few fine distinct grayish brown (10YR 5/2), yellowish brown (10YR 5/6), and brown (7.5YR 4/4) mottles; moderate medium prismatic structure parting to moderate medium and fine subangular blocky; firm; few dark oxides; stone line at 25 inches; mildly alkaline; gradual smooth boundary.

IIB31—35 to 47 inches; yellowish brown (10YR 5/6) loam; common fine distinct strong brown (7.5YR 5/8) and grayish brown (10YR 5/2) and few fine distinct brown (7.5YR 4/4) mottles; nearly continuous dark grayish brown (10YR 4/2) coatings on faces of prisms; moderate coarse prismatic structure parting to moderate medium and fine subangular blocky; firm; mildly alkaline; clear smooth boundary.

IIB32—47 to 54 inches; mottled strong brown (7.5YR 5/6) and grayish brown (10YR 5/2) loam; weak coarse prismatic structure parting to moderate medium subangular blocky; firm; common fine soft lime nodules; strong effervescence; mildly alklaine; gradual wavy boundary.

IIC—54 to 60 inches; mottled strong brown (7.5YR 5/6) and grayish brown (10YR 5/2) loam; massive; firm; common soft lime nodules; strong effervescence; mildly alkaline.

The thickness of the solum ranges from about 40 to 55 inches. The upper loamy material is 18 to 28 inches deep over the underlying firm glacial till.

The A horizon is black (N 2/0 or 10YR 2/1) in the upper part and black (10YR 2/1) or very dark gray (10YR 3/1) in the lower part. It is 15 to 22 inches thick. It is neutral or slightly acid. It is clay loam or silty clay loam high in content of sand. The B horizon is neutral or mildly alkaline. The IIB2 horizon has hue of 2.5Y or 5Y, value of 4 to 6, and chroma of 1 to 4 and has higher chroma mottles. The IIB and IIC horizons typically are loam, but the range includes clay loam and sandy clay loam.

Wapsie series

The Wapsie series consists of well drained soils on alluvial benches. These soils formed in loamy alluvial material 24 to 32 inches deep over coarse textured alluvium. They are moderately permeable in the subsoil and very rapidly permeable in the substratum. The native vegetation was prairie grasses and trees. Slope ranges from 0 to 2 percent.

Wapsie soils are similar to Saude soils and commonly are adjacent to Hayfield and Saude soils. They are in positions on the landscape similar to those of the adjacent soils. The dark surface layer of Saude soils is thicker than that of the Wapsie soils. Hayfield soils are somewhat poorly drained. The upper part of their B horizon is grayer than that of the Wapsie soils.

Typical pedon of Wapsie loam, 0 to 2 percent slopes, 1,056 feet north and 320 feet west of the center of sec. 18, T. 89 N., R. 9 W.

Ap—0 to 7 inches; very dark grayish brown (10YR 3/2) loam, grayish brown (10YR 5/2) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

A2—7 to 10 inches; brown (10YR 4/3) loam, grayish brown (10YR 5/2) dry; nearly continuous very dark grayish brown (10YR 3/2) coatings on faces of peds; weak thin platy structure parting to weak fine subangular blocky; friable; neutral; clear smooth boundary.

B21t—10 to 17 inches; brown (10YR 4/3) loam; nearly continuous dark brown (10YR 3/3) coatings on faces of peds; weak fine subangular blocky

structure; friable; thin discontinuous clay films on faces of peds; medium acid; gradual smooth boundary.

B22t—17 to 27 inches; brown (7.5YR 4/4) loam; few thin discontinuous dark brown (10YR 3/3) coatings on faces of peds; moderate medium and fine subangular blocky structure; friable; thin discontinuous clay films on faces of peds; medium acid; clear smooth boundary.

IIC—27 to 60 inches; brown (7.5YR 4/4) gravelly coarse sand; single grain; loose; medium acid.

The thickness of the solum ranges from 24 to 40 inches. The depth to the IIC horizon ranges from 24 to 32 inches.

The Ap horizon is very dark brown (10YR 2/2) or very dark grayish brown (10YR 3/2). It is 6 to 10 inches thick. The A1 horizon, if it occurs, is black (10YR 2/1) or very dark gray (10YR 3/1). The A2 horizon has hue of 10YR, value of 4 or 5, and chroma of 2 or 3. The A horizon is loam or silt loam high in content of sand. The B2 horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 3 to 8. It is loam or sandy clay loam. The content of clay in this horizon ranges from about 15 to 22 percent. The C horizon is gravelly coarse sand, loamy sand, or sand and some gravel.

Watseka series

The Watseka series consists of somewhat poorly drained, rapidly permeable soils on alluvial benches and uplands. These soils formed in sandy material deposited dominantly by wind but, in some areas, by water. The native vegetation was prairie grasses. Slope ranges from 1 to 3 percent.

Watseka soils are similar to Chelsea and Sparta soils and commonly are adjacent to Marshan soils. The dark A horizon of Chelsea soils is thinner than that of the Watseka soils. Sparta soils are excessively drained. Their B horizon is browner than that of the Watseka soils. Marshan soils are in the lower lying areas. They contain less sand in the upper part of the solum than the Watseka soils. Also, their B horizon is grayer.

Typical pedon of Watseka loamy fine sand, 1 to 3 percent slopes, 2,015 feet east and 130 feet north of the southwest corner of sec. 31, T. 90 N., R. 10 W.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loamy fine sand, dark grayish brown (10YR 4/2) dry; weak fine granular structure; very friable; neutral; abrupt smooth boundary.

A12—8 to 17 inches; very dark grayish brown (10YR 3/2) loamy fine sand, dark grayish brown (10YR 4/2) dry; weak coarse subangular blocky structure; very friable; slightly acid; clear smooth boundary.

B2—17 to 23 inches; mottled grayish brown (2.5Y 5/2), dark grayish brown (10YR 4/2), and brown (7.5YR 4/4) loamy fine sand; weak coarse subangular blocky structure; very friable; slightly acid; gradual smooth boundary.

B3—23 to 34 inches; brown (10YR 4/3) loamy fine sand; common medium distinct grayish brown (2.5Y 5/2) and few medium distinct brown (7.5YR 4/2) mottles; weak fine subangular blocky structure; very friable; a 1/4- to 1/2-inch reddish brown horizontal band at 29 inches; slightly acid; abrupt wavy boundary.

C—34 to 60 inches; light brownish gray (2.5Y 6/2) sand; single grain; loose; slightly acid.

The solum ranges from 24 to 36 inches in thickness. The A horizon has hue of 10YR, value of 2 or 3, and chroma of 1 or 2. It is loamy fine sand or sand. The B horizon has hue of 7.5YR, 10YR, 2.5Y, or 5Y, value of 4 to 7, and chroma of 2 to 4. It ranges from slightly acid to strongly acid. The B and C horizons typically are loamy fine sand or sand. Some pedons contain gravel. The C horizon ranges from medium acid to neutral. It has colors similar to those of the B horizon, but in some pedons the chroma is 1.

Waukee series

The Waukee series consists of well drained soils on alluvial benches. These soils formed in 32 to 40 inches of loamy alluvial material and in the underlying coarse textured alluvium. They are moderately permeable in the subsoil and very rapidly permeable in the substratum. The native vegetation was prairie grasses. Slope ranges from 0 to 2 percent.

Waukee soils are similar to Saude soils and commonly are adjacent to Lawler, Marshan, Saude, and Wapsie soils. Saude soils are shallower to coarse textured material than the Waukee soils. The somewhat poorly drained Lawler and poorly drained Marshan soils are in the lower lying areas. Their B horizon is grayer than that of the Waukee soils. The A horizon of Wapsie soils is thinner than that of the Waukee soils. Saude and Wapsie soils are in positions on the landscape similar to those of the Waukee soils.

Typical pedon of Waukee loam, 0 to 2 percent slopes, 1,850 feet east and 495 feet north of the southwest corner of sec. 31, T. 89 N., R. 7 W.

Ap—0 to 8 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

A12—8 to 13 inches; black (10YR 2/1) loam, very dark gray (10YR 3/1) dry; weak fine granular structure; friable; slightly acid; gradual smooth boundary.

A13—13 to 18 inches; very dark brown (10YR 2/2) loam, very dark grayish brown (10YR 3/2) dry; some brown (10YR 4/3) streaks in the lower part; weak fine granular structure; friable; slightly acid; clear smooth boundary.

B1—18 to 23 inches; brown (10YR 4/3) loam, brown (10YR 4/3) kneaded; weak fine subangular blocky

structure; friable; discontinuous dark brown coatings on faces of peds; medium acid; gradual smooth boundary.

B21—23 to 29 inches; brown (10YR 4/3) loam; weak medium and fine subangular blocky structure; friable; discontinuous dark brown (10YR 3/3) coatings on faces of peds; medium acid; gradual smooth boundary.

B22—29 to 33 inches; brown (10YR 4/3) loam; weak medium and fine subangular blocky structure; friable; nearly continuous dark brown (10YR 3/3) coatings on faces of peds; medium acid; clear wavy boundary.

IIB31—33 to 36 inches; brown (10YR 4/3) sandy loam; weak medium and fine subangular blocky structure; very friable; discontinuous dark brown (10YR 3/3) coatings on faces of peds; medium acid; clear wavy boundary.

IIB32—36 to 45 inches; yellowish brown (10YR 5/4) gravelly loamy sand; weak medium and fine subangular blocky structure; very friable; medium acid; gradual smooth boundary.

IIC—45 to 60 inches; yellowish brown (10YR 5/4) gravelly sand; single grain; loose; medium acid.

The thickness of the solum ranges from 30 to 48 inches. The depth to sandy and gravelly material is 32 to 40 inches.

The A horizon is black (10YR 2/1) or very dark brown (10YR 2/2). It is loam or silt loam high in content of sand. It is 12 to 18 inches thick. The B horizon has hue of 10YR, value of 4 or 5, and chroma of 3 to 6. It is loam or sandy clay loam. The content of clay in this horizon ranges from 18 to 24 percent. The IIB horizon is loam, sandy clay loam, sandy loam, or gravelly loamy sand. The C horizon is coarse loamy sand, gravelly sand, or sand. The content of gravel, by volume, in this horizon dominantly is about 10 to 20 percent but is as much as 50 percent in some pedons.

Whalan series

The Whalan series consists of well drained, moderately permeable soils on convex ridges in the uplands. These soils formed in silty and loamy material and in the underlying layer of limestone residuum. The native vegetation was trees. Slope ranges from 2 to 5 percent.

Whalan soils commonly are adjacent to Nordness and Rockton soils. Nordness soils are in convex areas on the lower parts of the landscape. They are shallower to limestone bedrock than the Whalan soils. Rockton soils are in positions on the landscape similar to those of the Whalan soils. Their A horizon is thicker and darker than that of the Whalan soils.

Typical pedon of Whalan silt loam, 30 to 40 inches to limestone, 2 to 5 percent slopes, 395 feet east and 500 feet north of the southwest corner of sec. 28, T. 90 N., R. 10 W.

A1—0 to 3 inches; very dark gray (10YR 3/2) silt loam, dark gray (10YR 4/1) dry; weak fine granular structure; friable; neutral; abrupt smooth boundary.

A2—3 to 9 inches; brown (10YR 5/3) silt loam, light gray (10YR 7/2) dry; weak thin platy structure; friable; medium acid; clear smooth boundary.

B1—9 to 14 inches; yellowish brown (10YR 5/4) silt loam high in content of very fine sand; weak fine subangular blocky structure; friable; strongly acid; clear smooth boundary.

B21t—14 to 22 inches; yellowish brown (10YR 5/4) loam; moderate fine angular and subangular blocky structure; friable; nearly continuous dark yellowish brown (10YR 4/4) coatings on faces of peds; discontinuous clay films on faces of peds; strongly acid; gradual smooth boundary.

B22t—22 to 27 inches; yellowish brown (10YR 5/6) clay loam; common medium distinct strong brown (7.5YR 5/6) mottles; moderate medium and fine subangular blocky structure; firm; some discontinuous clay films and clay filled pores; medium acid; gradual smooth boundary.

B23—27 to 31 inches; strong brown (7.5YR 5/8) clay loam; moderate fine angular blocky structure; firm; medium acid; gradual wavy boundary.

IIB3—31 to 36 inches; yellowish brown (10YR 5/6) silty clay; massive; firm; few dark brown (7.5YR 3/2) clay streaks and clay filled pores; neutral; abrupt wavy boundary.

IIR—36 inches; fractured limestone bedrock; thin coatings of yellowish brown (10YR 5/6) clayey residuum between the upper slabs of limestone.

The thickness of the solum, or the depth to limestone, ranges from 20 to 40 inches. In uneroded areas the A1 horizon is black (10YR 2/1) or very dark gray (10YR 3/1). It is 1 to 4 inches thick. In cultivated areas the Ap horizon is dark grayish brown (10YR 4/2) or brown (10YR 4/3). The A2 horizon is dark grayish brown (10YR 4/2), grayish brown (10YR 5/2), or brown (10YR 5/3). The A horizon is silt loam or loam. The upper part of the B horizon ranges from brown (10YR 4/3) to yellowish brown (10YR 5/6). The B2 horizon is loam or clay loam. It is medium acid to very strongly acid. The IIB horizon is slightly acid to mildly alkaline. It is clay loam or silty clay. It is 2 to 6 inches thick.

formation of the soils

This section describes the factors of soil formation, relates them to the soils in the county, and explains the processes of soil formation.

factors of soil formation

Soil forms through processes that act on deposited or accumulated geologic material. The characteristics of the soil at any given point are determined by the physical and mineralogical composition of the parent material, the climate during and after the accumulation of the soil material, the plant and animal life on and in the soil, the relief, and the length of time that the forces of soil formation have acted on the soil material (*4*). Also important are human activities.

Climate and plants are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it into a natural body that has genetically related horizons. The effects of climate and plants are conditioned by relief. The parent material affects the kind of soil profile that forms and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil. A long period generally is needed for the formation of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four.

parent material and geology

The accumulation of parent material is the first step in the formation of a soil. Some of the soils in the county formed in material that remained in place after it weathered from bedrock. Most of the soils, however, formed in material transported from the site of the parent rock and redeposited through the action of glacial ice, water, wind, or gravity. The principal parent materials in Buchanan County are glacial drift, loess, alluvium, and eolian, or wind-deposited, sand. Much less extensive are organic deposits and residuum.

Glacial drift is all rock material transported and deposited by glacial ice, including the material sorted by melt water and glacial till. Glacial till is unsorted sediment in which particles range in size from boulders to clay. Glacial drift is the most extensive parent material in Buchanan County. At least twice during the glacial period, continental ice or glaciers moved over the land. These ice invasions are evidenced by the unconsolidated rock material that was deposited by the melting ice and melt water streams. The older ice sheet, known as the Nebraskan, covered the area about 750,000 years ago (*8*). It was followed by the Aftonian interglacial period. The Kansan glaciation probably started about 500,000 years ago. A more recent glaciation, the Iowan substage of the Wisconsin glaciation, was recognized in a study by Leighton (*5*), but recent studies of the presence and identification of Iowan glacial till indicate that the conclusions formed from studies made before 1960 are questionable. Intensive, detailed geomorphic and stratigraphic work shows that the landscape is a multilevel sequence of erosion surfaces and that many of the levels are cut into Kansan and Nebraskan till (*10*). Landscapes similar to those in Buchanan County have been studied in detail by Ruhe (*8*). Subsurface investigations and studies demonstrated that the Iowan till does not exist but that an erosion-surface complex does exist in the Iowa region. The Iowan surface is multilevel and is arranged in a series of steps from the major drainageways toward bounding divides. It is marked by a stone line where it cuts through Kansan and Nebraskan till. The stone line occurs on all levels of the stepped surfaces, and it passes under the alluvium along the drainageways.

Bassett, Clyde, Cresco, Donnan, Floyd, Kenyon, Oran, Protivin, Readlyn, and Tripoli soils formed in glacial drift and glacial till on the Iowan erosion surface. The loamy surficial sediments generally are about 1 to 2 feet deep over the glacial material. They are deeper, however, in areas of Clyde, Floyd, and other soils on the lower concave slopes and in waterways. A stone line or band of pebbles commonly separates the friable, loamy surficial sediments from the firm loam or clay loam glacial till (*7*) (fig. 16).

Alluvium is sediment transported and deposited by water. It is the second most extensive parent material in Buchanan County. Alluvial deposits of Late Wisconsin age are on the flood plains and terraces along watercourses. They consist of lenses and layers of sand, gravel, silt, and clay. They vary in thickness. Along the major streams they are as much as 80 feet thick.

When streams overflow their channels and the water spreads over the flood plains, the coarse textured material is deposited first. As the floodwater spreads, it

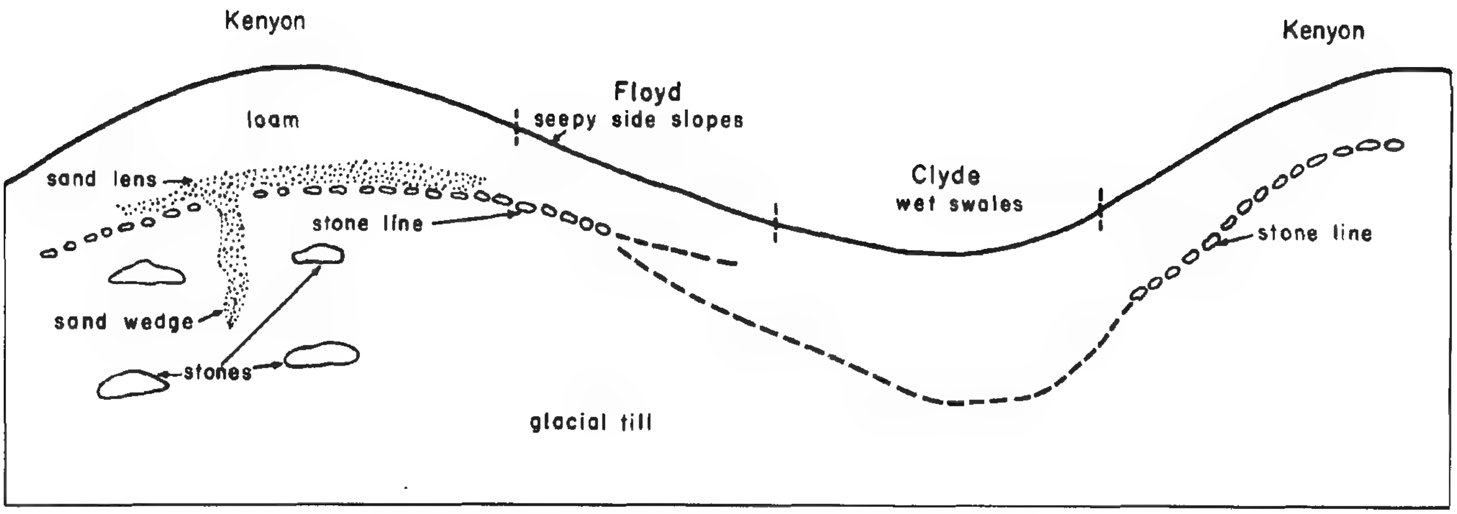

Figure 16.—The parent material of Kenyon, Clyde, and Floyd soils.

moves more slowly and fine textured sediments, such as silt, are deposited. After the floodwater has receded, the finest material, or clay, settles from the water that is left standing on the lowest part of the flood plain, generally some distance from the main channel. Near the channel, or within the present meander belt, are recent alluvial soils. Spillville-Coland complex, channeled, 0 to 2 percent slopes, is on some sand bars next to the channel. The soils in this complex contain varying amounts of sand, silt, and clay. On bottom land, away from the meander belt, Spillville soils and the soils in the Spillville-Coland complex, 0 to 2 percent slopes, formed. They consist mainly of silt, sand, and some clay.

The soils on alluvial benches or second and third bottoms are at the higher elevations. They vary in texture. Examples are Waukee and Saude soils, which formed in loamy alluvium and in the underlying sand and gravel.

Some alluvial material has been transported only a short distance and has accumulated at the foot of the slope on which it originated. This material is called local alluvium and retains many characteristics of the soils in the areas from which it has eroded. Clyde and Floyd soils are examples of loamy soils that formed partly in sediments removed from adjacent areas of glacial till on side slopes.

Textural differences are accompanied by some differences in the chemical and mineralogical composition of the alluvium. Most alluvial soils in Buchanan County are free of carbonates and are neutral or slightly acid. One exception is Dells silt loam, 0 to 2 percent slopes, which is medium acid or strongly acid in the B horizon.

Eolian, or wind-deposited, sand is in the uplands and on benches. It is the third most extensive parent material in Buchanan County. In the glacial till uplands, it occurs as low mounds or dunes and is underlain by till at varying depths. The sand also occurs as areas intermingled with soils that formed in loess. It is mainly quartz, which is very fine and fine in size and is highly resistant to weathering. It has not been altered appreciably since it was deposited. Chelsea, Dickinson, Lamont, and Sparta soils formed mainly in this material.

Loess of Wisconsin age is not an extensive parent material in Buchanan County. It is mainly in the northwest quadrant of the county, but it also occurs as a wedge-shaped area in Liberty Township. In most areas it was deposited as a mantle over the glacial drift. It consists of accumulated particles of silt and clay that have been deposited by wind. Unweathered loess is calcareous silt loam.

The loess in Buchanan County generally is less than 10 feet thick. Seaton soils formed in loess more than 40 inches thick. They contain less sand than most of the other soils in the county. Dinsdale, Franklin, Klinger, and Maxfield soils formed both in loess and in the underlying glacial till. They are in upland areas where the loess is only 20 to 40 inches thick because of erosion.

Organic deposits of plant material accumulated in old lakebeds or swamps that supported a dense stand of water-tolerant plants. The organic soils in this county are in small wet areas where poor drainage has retarded the decay of plant remains. In most areas the organic material ranges from 18 to 52 inches in thickness, but in

a few areas it is more than 52 inches thick. Palms soils formed in organic material.

Residuum is material derived from sedimentary rock that weathered in place. It is a very minor parent material in the county. The underlying bedrock is of the Devonian period.

climate

The soils in Buchanan County formed under a midcontinental, subhumid climate for at least 5,000 years. Between 5,000 and 16,000 years ago, the climate was conducive to the growth of forest vegetation (*6*). The morphology of most of the soils indicates that the climate under which the soils formed is similar to the present one. The present climate generally is uniform throughout the county but is marked by wide seasonal extremes in temperature. Precipitation is distributed throughout the year.

Climate is a major factor in determining the characteristics of soils. It affects the rate and intensity of hydrolysis, carbonation, oxidation, and other important chemical reactions. Temperature, rainfall, relative humidity, and length of the frost-free period are important in determining the kind of vegetation on the soil.

The influence of the general climate of the region is somewhat modified by local conditions. For example, soils on south-facing slopes formed under a microclimate that is warmer and drier than that of the soils in nearby areas. Also, the low-lying, poorly drained soils formed under a microclimate that is wetter and colder than that of most of the surrounding soils. These local conditions account for some of the differences among the soils in the county.

plant and animal life

Living organisms are important in soil formation. These include vegetation, animals, bacteria, and fungi. The vegetation helps to determine the content of organic matter, the color of the surface layer, and the content of nutrients. Earthworms and other burrowing animals help to keep the soil open and porous. Bacteria and fungi decompose the vegetation and thereby release plant nutrients.

Most of the soils in Buchanan County formed under prairie grasses or a mixture of prairie grasses and water-tolerant plants. Many decayed roots and tops of grasses are on or in the soils. As a result, the surface layer of many soils is thick and dark. Klinger and Tripoli soils are examples.

The soils that formed under trees have a thinner, lighter colored surface layer than those that formed under grasses. They derive organic matter principally from fallen leaves. Lamont and Chelsea soils are examples.

Many soils formed first under prairie grasses and then under a combination of prairie grasses and trees. Franklin soils are an example. Bassett and Kenyon soils formed in the same kind of parent material and under similar conditions, but the native vegetation on Bassett soils was prairie grasses and trees and that on Kenyon soils was prairie grasses. The native vegetation accounts for the main morphological differences between these soils.

relief

Relief affects the formation of soils mainly through its effect on drainage, runoff, and erosion. The soils in Buchanan County generally range from level to moderately steep but in some small areas are very steep. Water soaks into the nearly level soils that are not flooded. On the steeper soils, more water runs off the surface. Dinsdale, Klinger, and Maxfield soils, which formed in the same kind of parent material and under similar vegetation, differ from one another because of relief and position on the landscape. The nearly level Maxfield soils are in wide areas at the head of drainageways. The very gently sloping Klinger soils are on ridges and long, concave slopes. The gently sloping Dinsdale soils are on uplands. Steeply sloping soils have weakly expressed profiles because most of the precipitation that they receive runs off the surface. Sogn soils are an example.

In depressions that collect and impound water, the soils are more poorly drained than the higher lying adjacent soils and have a distinct, lighter colored subsurface layer and a gray subsoil. Examples are soils in depressional areas adjacent to Dells soils.

Soils that formed in alluvium, such as Coland, Saude, and Spillville soils, are on bottom land or alluvial benches. Even though they are nearly level, their microrelief affects the runoff rate, the depth to the water table, and the amount of new sediment that is added. Coland soils, which are at low elevations, are poorly drained, have a high water table, and impound water for short periods. Spillville soils, which are at slightly higher elevations, are somewhat poorly drained or moderately well drained. Saude soils, which are at the higher elevations, are well drained, are not subject to flooding, and do not impound water.

Aspect has a significant effect on soil formation. South-facing slopes generally are warmer and drier than north-facing slopes. As a result, they support a different kind and amount of vegetation.

The influence of a porous, rapidly permeable parent material can override the influence of relief. Even though they are nearly level to gently sloping, Dickinson soils, for example, are somewhat excessively drained because they have moderately rapid permeability.

time

The length of time that the soil material remains in place and is acted on by the soil-forming processes affects the kind of soil that forms. The older soils have

strongly expressed genetic horizons. Donnan soils are an example. The younger soils have only weakly expressed horizons. Some soils that formed in alluvium show little or no evidence of soil formation because fresh material is deposited periodically. They have not been in place long enough for the climate and vegetation to form well defined genetic horizons. Spillville soils are an example.

The resistance of soil material to weathering can modify the effect of time. Soils that formed in material resistant to weathering, such as quartz sand, do not change much with time. Chelsea and Sparta soils are examples.

The loess that covered parts of Buchanan County was probably deposited 14,000 to 20,000 years ago (*9*). The Iowan erosion surface beneath the loess formed during the period when the loess was deposited (*10*). As a result, it could be as young as 14,000 years old. Bassett, Kenyon, and Readlyn soils are in the higher areas on this surface. They are older than Clyde, Floyd, and Schley soils, which are in the lower areas. The surface not covered by loess could be younger than the loess. In areas where it is covered by loam sediments, the surface is less than 14,000 years old (*10*). The soils in these areas are probably much younger.

human activities

Important changes took place after Buchanan County was settled. Some had little effect on soil productivity, but others had drastic effects. Changes caused by water erosion are the most significant. In the more sloping areas, cultivation has increased the susceptibility to erosion, which removes topsoil, organic matter, and plant nutrients. Sheet erosion, which is the most prevalent kind of erosion in the county, removes a few inches of topsoil at a time, but cultivation generally destroys all evidence of this loss. The moderately eroded Bassett, Kenyon, and Seaton soils show the effect of cultivation.

Wind erosion also occurs after the soil is cultivated. Light textured soils are highly susceptible to wind erosion, especially if the surface is bare and the topsoil is dry. After nearly level fields are plowed in the fall, dark topsoil is mixed with snow or piled along fence rows and road ditches.

In fields that are cultivated year after year, the well developed granular structure of the surface layer, so apparent in virgin grassland, begins to break down. The surface layer generally is baked and hard when dry. The fine textured soils that are plowed when wet tend to puddle and are less permeable than similar soils in uncultivated areas. In some fields of finer textured soils, a compact layer forms below the plow layer. This compact layer hardens when it dries and is less permeable than the subsoil. It is called a plowsole or plowpan.

Management practices have increased the productivity of some soils and reclaimed areas that otherwise are not suitable for crops. Crops can be grown, for example, in areas where drainage ditches and diversions at the foot of slopes help to prevent flooding on bottom land. Drainage tile has reduced the wetness of some soils, and terraces have provided protection against erosion. Applications of commercial fertilizer have counteracted deficiencies in plant nutrients and have thus increased the productivity of some soils.

processes of soil formation

At least four processes were involved in the formation of soils in Buchanan County (*11*). These processes are the accumulation of organic matter, the leaching of calcium carbonates and other bases, the reduction and transfer of iron, and the formation and translocation of silicate clay minerals. In most soils more than one of these processes have been active in the formation of horizons.

The accumulation of organic matter in the upper part of the profile helps to form an A1 horizon. Generally, the soils that have a high content of organic matter also have a thick, dark surface layer. Maxfield soils are an example.

Carbonates and other bases have been leached from the upper horizons of nearly all of the soils in the county. Leaching probably precedes the translocation of silicate clay minerals.

Leaching of bases and translocation of silicate clays are among the more important processes affecting horizon differentiation. Clay particles accumulate in pores, and clay films form on the faces of peds along which water moves. Klinger soils are an example of soils in which translocated silicate clays in the form of clay films have accumulated in the B2t horizon.

The reduction and transfer of iron, a process called gleying, is evident in Coland, Tripoli, and other poorly drained soils. The gray color of the subsoil indicates the reduction and the loss of iron. Mottles, which occur in some horizons, indicate the segregation of iron.

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glossary

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Coarse textured soil. Sand or loamy sand.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the removal of water from the soil. Drainage classes are determined on the basis of an overall evaluation of water removal as influenced by climate, slope, and position on the landscape. Precipitation, runoff, amount of moisture infiltrating the soil, and rate of water movement through the soil affect the degree and duration of wetness. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. The soils in this class generally are free of mottles throughout. They commonly are shallow, very porous, or steep, or a combination of these.

Somewhat excessively drained.—Water is removed from the soil rapidly. The soils in this class generally are free of mottles throughout. They commonly are shallow or moderately deep, very porous, or steep, or a combination of these.

Well drained.—Water is removed from the soil so readily that the upper 40 inches generally does not have the mottles or dull colors related to wetness.

Moderately well drained.—Water is removed from the soil so slowly that the upper 20 to 40 inches has the mottles or dull colors related to wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Somewhat poorly drained.—Water is removed from the soil so slowly that the upper 10 to 20 inches has the mottles or dull colors related to wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Poorly drained.—Water is removed so slowly that either the soil is periodically saturated or the upper 10 inches has the mottles or dull colors related to wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water is at or on the surface most of the time. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Fast intake (in tables). The rapid movement of water into the soil.

Fine textured soil. Sandy clay, silty clay, and clay.

First bottom. The normal flood plain of a stream, subject to frequent or occasional flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Glacial drift (geology). Pulverized and other rock material transported by glacial ice and then deposited. Also the sorted and unsorted material deposited by streams flowing from glaciers.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial melt water.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Gleyed soil. Soil that formed under poor drainage, resulting in the reduction of iron and other elements in the profile and in gray colors and mottles.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Mineral soil. Soil that is mainly mineral material and low in organic material. Its bulk density is more than that of organic soil.

Moderately coarse textured soil. Sandy loam and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Muck. Dark colored, finely divided, well decomposed organic soil material. (See Sapric soil material.)

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Outwash, glacial. Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by glacial melt water.

Paleosol. An antiquated soil that formed during the geologic past and was buried and preserved by more recent sedimentation. Subsequent erosion commonly has exposed the buried soil.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.20 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Ponding. Standing water on soils in closed depressions. The water can be removed only by percolation or evapotranspiration.

Poorly graded. Refers to a coarse grained soil or soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor filter (in tables). Because of rapid permeability or an impermeable layer near the surface, the soil may not adequately filter effluent from a waste disposal system.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sapric soil material (muck). The most highly decomposed of all organic soil material. Muck has the least amount of plant fiber, the highest bulk density, and the lowest water content at saturation of all organic soil material.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to insure satisfactory performance of the soil for a specific use.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 mm in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows:

	Millimeters
Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stone line. A concentration of coarse fragments in a soil. Generally it is indicative of an old weathered surface. In a cross section, the line may be one fragment or more thick. It generally overlies material that weathered in place and is overlain by recent sediment of variable thickness.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the profile below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A1, A2, or A3) below the surface layer.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A horizon. Includes all subdivisions of this horizon (A1, A2, and A3).

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Well graded. Refers to soil material consisting of coarse grained particles that are well distributed over a wide range in size or diameter. Such soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

Month	Temperature*						Precipitation*				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days**	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January	26.0	6.6	16.3	49	-24	0	.75	.21	1.18	2	4.7
February	31.5	12.4	22.0	54	-18	0	.97	.25	1.53	3	5.7
March	42.2	23.3	32.7	74	-4	8	1.98	1.12	2.68	5	7.7
April	59.3	36.5	47.9	86	16	72	3.10	1.99	4.10	7	.8
May	71.1	47.3	59.2	90	27	304	4.21	2.80	5.48	8	.0
June	80.3	57.0	68.7	95	41	561	4.76	2.96	6.37	8	.0
July	84.0	60.7	72.4	97	46	694	4.40	2.54	5.92	7	.0
August	82.2	58.0	70.0	94	42	620	3.78	2.16	5.09	6	.0
September	74.4	49.4	61.9	92	30	357	3.60	1.61	5.21	7	.0
October	63.9	39.1	51.5	86	19	159	2.33	.91	3.49	5	.0
November	45.9	26.3	36.1	71	3	6	1.62	.64	2.41	3	2.1
December	31.6	14.2	22.9	58	-21	0	1.15	.57	1.62	3	6.7
Year	57.7	35.9	46.8	97	-27	2,781	32.65	27.43	37.64	64	27.7

* Recorded in the period 1951-74 at Independence, Iowa.

** A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

Probability	Temperature*		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	April 29	May 8	May 20
2 years in 10 later than--	April 23	May 2	May 15
5 years in 10 later than--	April 11	April 21	May 4
First freezing temperature in fall:			
1 year in 10 earlier than--	October 11	October 1	September 16
2 years in 10 earlier than--	October 16	October 7	September 22
5 years in 10 earlier than--	October 26	October 16	October 3

* Recorded in the period 1951-74 at Independence, Iowa.

TABLE 3.--GROWING SEASON

Probability	Daily minimum temperature during growing season*		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	179	154	129
8 years in 10	186	162	137
5 years in 10	198	177	151
2 years in 10	210	192	165
1 year in 10	216	200	172

* Recorded in the period 1951-74 at Independence, Iowa.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
41	Sparta loamy fine sand, 0 to 2 percent slopes	1,085	0.3
41B	Sparta loamy fine sand, 2 to 5 percent slopes	10,410	2.9
41C	Sparta loamy fine sand, 5 to 9 percent slopes	715	0.2
63B	Chelsea loamy fine sand, 2 to 5 percent slopes	3,335	0.9
63C	Chelsea loamy fine sand, 5 to 9 percent slopes	655	0.2
83B	Kenyon loam, 2 to 5 percent slopes	68,610	18.8
83C	Kenyon loam, 5 to 9 percent slopes	380	0.1
83C2	Kenyon loam, 5 to 9 percent slopes, moderately eroded	1,540	0.4
84	Clyde clay loam, 0 to 3 percent slopes	22,050	6.1
109B	Backbone fine sandy loam, 2 to 6 percent slopes	630	0.2
110	Lamont fine sandy loam, 0 to 2 percent slopes	235	0.1
110B	Lamont fine sandy loam, 2 to 5 percent slopes	1,310	0.4
141	Watseka loamy fine sand, 1 to 3 percent slopes	335	0.1
151	Marshan clay loam, 24 to 32 inches to sand and gravel, 0 to 2 percent slopes	1,555	0.4
152	Marshan clay loam, 32 to 40 inches to sand and gravel, 0 to 2 percent slopes	2,840	0.8
159	Finchford loamy sand, 0 to 2 percent slopes	995	0.3
159C	Finchford loamy sand, 2 to 9 percent slopes	510	0.1
171B	Bassett loam, 2 to 5 percent slopes	6,250	1.7
171C2	Bassett loam, 5 to 9 percent slopes, moderately eroded	525	0.1
175	Dickinson fine sandy loam, 0 to 2 percent slopes	490	0.1
175B	Dickinson fine sandy loam, 2 to 5 percent slopes	1,850	0.5
177	Saude loam, 0 to 2 percent slopes	3,680	1.0
177B	Saude loam, 2 to 5 percent slopes	260	0.1
178	Waukee loam, 0 to 2 percent slopes	895	0.2
184	Klinger silty clay loam, 1 to 3 percent slopes	1,250	0.3
198B	Floyd loam, 1 to 4 percent slopes	8,430	2.3
205B	Whalan silt loam, 30 to 40 inches to limestone, 2 to 5 percent slopes	380	0.1
207B	Whalan silt loam, 20 to 30 inches to limestone, 2 to 5 percent slopes	450	0.1
213B	Rockton loam, 30 to 40 inches to limestone, 2 to 6 percent slopes	635	0.2
214	Rockton loam, 20 to 30 inches to limestone, 0 to 2 percent slopes	355	0.1
221	Palms muck, 1 to 4 percent slopes	590	0.1
225	Lawler loam, 24 to 32 inches to sand and gravel, 0 to 2 percent slopes	1,750	0.5
226	Lawler loam, 32 to 40 inches to sand and gravel, 0 to 2 percent slopes	460	0.1
241B	Burkhardt-Saude complex, 2 to 5 percent slopes	1,495	0.4
284	Flagler sandy loam, 0 to 2 percent slopes	2,510	0.7
284B	Flagler sandy loam, 2 to 5 percent slopes	710	0.2
290	Dells silt loam, 0 to 2 percent slopes	345	0.1
354	Aquolls, ponded	330	0.1
377B	Dinsdale silt loam, 2 to 5 percent slopes	755	0.2
382	Maxfield silty clay loam, 0 to 2 percent slopes	1,270	0.3
391B	Clyde-Floyd complex, 1 to 4 percent slopes	93,100	25.6
398	Tripoli clay loam, 0 to 2 percent slopes	11,025	3.0
399	Readlyn loam, 1 to 3 percent slopes	27,915	7.7
407B	Schley loam, 1 to 4 percent slopes	2,425	0.7
408B	Olin fine sandy loam, 2 to 5 percent slopes	22,620	6.2
408C	Olin fine sandy loam, 5 to 9 percent slopes	1,145	0.3
412C	Sogn loam, 2 to 9 percent slopes	535	0.1
471	Oran loam, 1 to 3 percent slopes	8,765	2.4
485	Spillville loam, 0 to 2 percent slopes	930	0.3
499B	Nordness loam, 2 to 5 percent slopes	280	0.1
499D	Nordness loam, 5 to 14 percent slopes	490	0.1
499F	Nordness loam, 14 to 30 percent slopes	380	0.1
585	Spillville-Coland complex, 0 to 2 percent slopes	3,915	1.1
663B	Seaton silt loam, 2 to 5 percent slopes	210	0.1
663C2	Seaton silt loam, 5 to 14 percent slopes, moderately eroded	275	0.1
663F	Seaton silt loam, 14 to 30 percent slopes	355	0.1
725	Hayfield loam, 24 to 32 inches to sand and gravel, 0 to 2 percent slopes	2,630	0.7
761	Franklin silt loam, 1 to 3 percent slopes	955	0.3
776	Lilah sandy loam, 0 to 2 percent slopes	635	0.2
776C	Lilah sandy loam, 2 to 9 percent slopes	1,090	0.3
777	Wapsie loam, 0 to 2 percent slopes	2,415	0.7
782B	Donnan loam, 2 to 6 percent slopes	1,220	0.3
798B	Protivin loam, 1 to 4 percent slopes	875	0.2
807B	Schley Variant sandy loam, 1 to 4 percent slopes	1,315	0.4
809B	Bertram fine sandy loam, 2 to 6 percent slopes	795	0.2
813	Atkinson loam, 0 to 2 percent slopes	380	0.1
883B	Cresco loam, 2 to 5 percent slopes	4,790	1.3
1585	Spillville-Coland complex, channeled, 0 to 2 percent slopes	19,250	5.3
5010	Pits, sand and gravel	140	*
5030	Pits, limestone quarries	210	0.1

See footnote at end of table.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
5040	Orthents, loamy	240	0.1
	Total	364,160	100.0

* Less than 0.1 percent.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields are those that can be expected under a high level of management. Only arable soils are listed. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Corn	Soybeans	Oats	Grass-legume hay	Smooth bromegrass	Bromegrass-alfalfa	Kentucky bluegrass
	Bu	Bu	Bu	Ton	AUM*	AUM*	AUM*
41----------------------- Sparta	63	24	47	2.5	3.6	3.6	2.0
41B---------------------- Sparta	61	23	45	2.5	3.4	3.4	2.0
41C---------------------- Sparta	56	21	42	2.3	3.1	3.1	1.8
63B---------------------- Chelsea	57	21	42	2.0	3.3	3.3	2.0
63C---------------------- Chelsea	52	20	39	1.8	3.0	3.0	1.8
83B---------------------- Kenyon	113	43	90	4.7	6.6	7.8	4.2
83C---------------------- Kenyon	108	41	86	4.5	6.5	7.5	4.0
83C2--------------------- Kenyon	105	40	84	4.4	6.3	7.3	3.8
84----------------------- Clyde	102	39	82	4.0	5.5	6.6	6.6
109B--------------------- Backbone	65	25	45	2.7	3.8	4.5	2.3
110---------------------- Lamont	71	27	53	2.5	3.6	4.1	2.4
110B--------------------- Lamont	69	26	52	2.5	3.5	4.1	2.3
141---------------------- Watseka	61	23	45	2.3	3.2	3.2	2.1
151---------------------- Marshan	89	33	67	3.8	5.3	5.8	5.8
152---------------------- Marshan	95	35	70	4.0	5.5	6.0	6.0
159---------------------- Finchford	45	15	35	1.5	2.0	2.5	1.5
159C--------------------- Finchford	35	14	30	1.2	1.6	2.0	1.3
171B--------------------- Bassett	107	40	85	4.5	6.5	7.5	4.0
171C2-------------------- Bassett	99	38	80	4.0	6.0	6.6	3.5
175---------------------- Dickinson	83	32	62	3.0	5.0	5.0	2.7
175B--------------------- Dickinson	81	31	60	3.0	4.8	5.0	2.7
177---------------------- Saude	78	30	62	3.3	4.6	5.5	3.0

See footnote at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Oats	Grass-legume hay	Smooth bromegrass	Bromegrass-alfalfa	Kentucky bluegrass
	Bu	Bu	Bu	Ton	AUM*	AUM*	AUM*
177B-- Saude	76	29	61	3.2	4.5	5.3	3.0
178-- Waukee	98	37	78	4.1	5.8	6.8	4.0
184-- Klinger	125	47	93	5.2	7.5	8.6	4.2
198B-- Floyd	106	40	85	4.5	6.9	7.5	4.1
205B-- Whalan	84	32	68	3.5	4.7	5.6	3.0
207B-- Whalan	64	24	51	2.7	3.8	5.0	2.5
213B-- Rockton	96	36	77	4.0	5.9	6.6	3.6
214-- Rockton	78	30	62	3.2	4.4	5.1	2.6
221-- Palms	80	30	65	3.2	3.8	---	---
225-- Lawler	85	32	68	3.6	5.0	6.0	3.7
226-- Lawler	100	38	80	4.2	6.0	7.0	4.0
241B-- Burkhardt-Saude	60	23	48	2.5	3.6	4.6	2.4
284-- Flagler	72	27	58	3.0	4.3	5.0	2.3
284B-- Flagler	70	26	56	2.9	4.1	4.8	2.1
290-- Dells	90	34	75	3.8	5.2	6.3	4.0
377B-- Dinsdale	119	45	89	5.0	7.1	8.3	4.1
382-- Maxfield	119	45	89	5.0	6.6	8.3	4.2
391B-- Clyde-Floyd	103	39	83	4.2	6.1	7.0	5.6
398-- Tripoli	111	42	89	4.5	6.5	7.5	4.1
399-- Readlyn	115	44	92	4.8	7.0	8.0	4.2
407B-- Schley	100	38	80	4.2	6.0	7.0	4.0
408B-- Olin	97	37	73	4.1	5.8	6.8	3.0
408C-- Olin	92	35	70	3.9	5.5	6.5	2.8

See footnote at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Corn	Soybeans	Oats	Grass-legume hay	Smooth bromegrass	Bromegrass-alfalfa	Kentucky bluegrass
	Bu	Bu	Bu	Ton	AUM*	AUM*	AUM*
412C------------------- Sogn	41	16	33	1.8	2.0	2.2	1.6
471------------------- Oran	109	41	87	4.6	6.5	7.6	4.0
485------------------- Spillville	122	46	98	5.1	7.3	8.6	4.2
499B------------------- Nordness	36	14	29	1.5	1.6	2.0	1.4
499D------------------- Nordness	---	---	20	1.2	1.2	2.0	1.0
499F------------------- Nordness	---	---	---	0.5	0.8	0.8	0.7
585------------------- Spillville-Coland	108	32	86	4.7	6.7	7.8	4.2
663B------------------- Seaton	113	34	90	4.7	6.6	7.8	4.2
663C2------------------- Seaton	105	30	84	4.4	6.1	7.0	3.8
663F------------------- Seaton	---	---	60	3.6	5.2	6.0	3.4
725------------------- Hayfield	79	30	63	3.0	4.3	5.0	3.0
761------------------- Franklin	117	44	87	4.8	7.0	8.0	4.0
776------------------- Lilah	45	17	36	1.6	1.6	2.6	1.3
776C------------------- Lilah	38	15	30	1.3	1.3	2.1	1.0
777------------------- Wapsie	72	27	57	3.0	4.3	5.0	2.7
782B------------------- Donnan	70	24	56	2.8	3.5	4.6	2.7
798B------------------- Protivin	88	33	70	3.7	5.3	6.1	3.6
807B------------------- Schley Variant	70	26	56	2.5	3.5	4.1	2.6
809B------------------- Bertram	65	25	45	2.2	3.6	4.5	2.5
813------------------- Atkinson	110	42	88	4.6	6.5	7.6	4.0
883B------------------- Cresco	88	33	70	3.7	5.3	6.1	3.3
1585------------------- Spillville-Coland	---	---	---	---	---	---	3.5

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

TABLE 6.--CAPABILITY CLASSES AND SUBCLASSES

[Miscellaneous areas are excluded. Absence of an entry indicates no acreage]

Class	Total acreage	Major management concerns (Subclass)		
		Erosion (e)	Wetness (w)	Soil problem (s)
		Acres	Acres	Acres
I	39,265	---	---	---
II	269,030	111,800	156,665	12,565
III	11,895	5,885	590	5,420
IV	23,165	---	---	23,165
V	19,250	---	19,250	---
VI	845	355	---	490
VII	380	---	---	380
VIII	---	---	330	---

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY

[Only the soils suitable for production of commercial trees are listed. Absence of an entry indicates that information was not available]

Soil name and map symbol	Ordination symbol	Management concerns: Erosion hazard	Management concerns: Equipment limitation	Management concerns: Seedling mortality	Management concerns: Windthrow hazard	Potential productivity: Common trees	Potential productivity: Site index	Trees to plant
41, 41B, 41C: Sparta	3s	Slight	Slight	Severe	Slight	Northern red oak Red pine Eastern white pine Jack pine	70 --- --- ---	Eastern white pine, red pine, jack pine.
63B, 63C: Chelsea	3s	Slight	Slight	Moderate	Slight	White oak Red pine Eastern white pine Jack pine Quaking aspen Northern red oak	70 72 83 70 72 70	Eastern white pine, red pine, jack pine.
109B: Backbone	3o	Slight	Slight	Slight	Slight	Northern red oak White oak	55 55	Eastern white pine, red pine, European larch, black walnut, sugar maple.
110, 110B: Lamont	3o	Slight	Slight	Slight	Slight	Northern red oak White oak	55 55	Eastern white pine, European larch.
171B, 171C2: Bassett	3o	Slight	Slight	Slight	Slight	White oak Northern red oak	55 55	Eastern white pine, red pine, European larch, black walnut, sugar maple.
205B, 207B: Whalan	2o	Slight	Slight	Slight	Slight	Eastern white pine Northern red oak White oak Black walnut	58 60 60 55	Northern red oak, white oak, silver maple, eastern white pine.
221: Palms	4w	Slight	Severe	Severe	Severe	White ash Red maple Quaking aspen Black willow Silver maple	51 51 56 --- 76	
241B*: Burkhardt	3s	Slight	Slight	Moderate	Slight	Northern pin oak Black oak Jack pine	52 --- ---	Eastern white pine, red pine, jack pine.
Saude.								
290: Dells	3o	Slight	Slight	Slight	Slight	Silver maple Northern red oak White ash	80 --- ---	Silver maple, white ash.
407B: Schley	3o	Slight	Slight	Slight	Slight	White oak Northern red oak	55 55	Eastern white pine, red pine, European larch, sugar maple.
471: Oran	3o	Slight	Moderate	Slight	Slight	White oak Northern red oak	55 55	Eastern white pine, red pine, European larch, sugar maple.
499B, 499D, 499F: Nordness	4d	Moderate	Moderate	Severe	Slight	Northern red oak White oak	45 45	
663B, 663C2: Seaton	2o	Slight	Slight	Slight	Slight	Yellow-poplar White oak Northern red oak Black walnut	90 90 80 ---	White oak, black walnut, northern red oak, green ash, red pine, sugar maple.

See footnote at end of table.

TABLE 7.--WOODLAND MANAGEMENT AND PRODUCTIVITY--Continued

Soil name and map symbol	Ordination symbol	Management concerns				Potential productivity		Trees to plant
		Erosion hazard	Equipment limitation	Seedling mortality	Windthrow hazard	Common trees	Site index	
663F: Seaton	2r	Moderate	Moderate	Moderate	Slight	Yellow-poplar White oak Northern red oak Black walnut	90 90 80 ---	White oak, black walnut, northern red oak, green ash, red pine, sugar maple.
725: Hayfield	2o	Slight	Slight	Slight	Slight	Northern red oak White oak Eastern white pine	63 63 58	Northern red oak, white oak, silver maple, eastern white pine.
761: Franklin	2o	Slight	Slight	Slight	Slight	White oak Northern red oak	65 65	Eastern white pine, white oak, black walnut, sugar maple, northern red oak.
776, 776C: Lilah	3s	Slight	Slight	Severe	Slight	Northern red oak	55	Eastern white pine, European larch.
777: Wapsie	3o	Slight	Slight	Slight	Slight	Northern red oak White oak	55 55	Eastern white pine, red pine, European larch, black walnut, sugar maple.
782B: Donnan	3o	Slight	Slight	Slight	Slight	White oak Northern red oak	55 55	Eastern white pine, red pine, European larch, black walnut, sugar maple.
807B: Schley Variant	3o	Slight	Slight	Slight	Slight	White oak Northern red oak	55 55	Eastern white pine, red pine, European larch, sugar maple.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of-- <8	8-15	16-25	26-35	>35
41, 41B, 41C------ Sparta	Siberian peashrub	Radiant crabapple, eastern redcedar, Amur honeysuckle, autumn-olive, Washington hawthorn, Tatarian honeysuckle, lilac.	Red pine, jack pine, Austrian pine.	Eastern white pine.	---
63B, 63C---------- Chelsea	Siberian peashrub	Eastern redcedar, autumn-olive, Russian-olive, lilac, Amur honeysuckle, Tatarian honeysuckle, Washington hawthorn.	Red pine, Austrian pine, Scotch pine.	Eastern white pine.	---
83B, 83C, 83C2---- Kenyon	Gray dogwood, silky dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
84---------------- Clyde	Silky dogwood, indiancurrant coralberry.	Redosier dogwood, American plum, Tatarian honeysuckle, Zabel honeysuckle.	Amur maple, northern white-cedar, laurel willow.	Green ash---------	Eastern cottonwood, silver maple.
109B-------------- Backbone	Gray dogwood, silky dogwood, lilac.	Eastern redcedar, American plum, redosier dogwood, Amur honeysuckle.	Eastern redcedar, Amur maple.	Eastern white pine, Norway spruce, red pine.	---
110, 110B--------- Lamont	Gray dogwood, silky dogwood.	Redosier dogwood, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Silver maple, eastern cottonwood.
141--------------- Watseka	Vanhoutte spirea, indiancurrant coralberry, gray dogwood.	Redosier dogwood, autumn-olive, eastern redcedar, silky dogwood, Amur honeysuckle.	Eastern white pine, Norway spruce, Amur maple.	Eastern white pine.	---
151, 152---------- Marshan	Silky dogwood, indiancurrant coralberry.	Redosier dogwood, northern white-cedar, American plum, Tatarian honeysuckle.	Amur maple--------	Golden willow, common hackberry, green ash.	Silver maple, eastern cottonwood.
159, 159C--------- Finchford	Siberian peashrub	Tatarian honeysuckle, Amur honeysuckle, Russian-olive, eastern redcedar, lilac, Washington hawthorn, autumn-olive.	Austrian pine, jack pine, red pine.	Eastern white pine.	---
171B, 171C2------- Bassett	Gray dogwood, silky dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
175, 175B: Dickinson	Silky dogwood, gray dogwood.	Redosier dogwood, Tatarian honeysuckle, American plum.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry, eastern white pine.	Silver maple.
177, 177B: Saude	Gray dogwood, silky dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry, eastern white pine.	Silver maple.
178: Waukee	Gray dogwood, silky dogwood.	Redosier dogwood, Tatarian honeysuckle, American plum.	Amur maple, eastern redcedar.	Red pine, Norway spruce, common hackberry, eastern white pine.	Silver maple.
184: Klinger	Gray dogwood, silky dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
198B: Floyd	Gray dogwood, silky dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
205B, 207B: Whalan	Gray dogwood, redosier dogwood, arrowwood.	Autumn-olive, silky dogwood, Amur honeysuckle, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Norway spruce, Douglas-fir, eastern white pine.	---
213B, 214: Rockton	Redosier dogwood, gray dogwood.	Autumn-olive, silky dogwood, Amur honeysuckle.	Eastern redcedar, Russian-olive.	Eastern white pine, Norway spruce, Douglas-fir.	American sycamore.
221: Palms	Common ninebark, whitebelle honeysuckle.	Amur honeysuckle, silky dogwood, Tatarian honeysuckle, Amur privet, nannyberry viburnum.	Tall purple willow.	Golden willow, black willow.	Imperial Carolina poplar.
225, 226: Lawler	Gray dogwood, silky dogwood.	Redosier dogwood, Tatarian honeysuckle.	Amur maple, eastern redcedar.	Common hackberry, red pine, Norway spruce.	Silver maple, eastern cottonwood.
241B*: Burkhardt	Gray dogwood	Tatarian honeysuckle, Siberian peashrub, lilac, Amur honeysuckle, eastern redcedar.	Norway spruce, Amur maple.	Eastern white pine, red pine, jack pine, Austrian pine.	---
Saude	Gray dogwood, silky dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry, eastern white pine.	Silver maple.
284, 284B: Flagler	Gray dogwood, silky dogwood.	Redosier dogwood, Tatarian honeysuckle, American plum.	Eastern redcedar, Amur maple, northern white-cedar.	Red pine, Norway spruce, common hackberry, eastern white pine.	---

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of-- <8	8-15	16-25	26-35	>35
290----------------- Dells	Gray dogwood, redosier dogwood.	Northern white-cedar, lilac, common ninebark, silky dogwood, Amur honeysuckle.	White spruce, Norway spruce, Amur maple.	Eastern white pine, red pine.	---
354*. Aquolls					
377B---------------- Dinsdale	Gray dogwood, silky dogwood.	Redosier dogwood, Amur honeysuckle, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
382----------------- Maxfield	Gray dogwood, silky dogwood.	Redosier dogwood, Tatarian honeysuckle, American plum.	Laurel willow, Amur maple, Zabel honeysuckle, northern white-cedar.	Green ash----------	Silver maple, eastern cottonwood.
391B*: Clyde--------------	Silky dogwood, indiancurrant coralberry.	Redosier dogwood, American plum, Tatarian honeysuckle, Zabel honeysuckle.	Amur maple, northern white-cedar, laurel willow.	Green ash----------	Eastern cottonwood, silver maple.
Floyd--------------	Gray dogwood, silky dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
398----------------- Tripoli	Silky dogwood-----	Redosier dogwood, American plum, Tatarian honeysuckle, autumn-olive, Zabel honeysuckle.	Amur maple, northern white-cedar, laurel willow.	Green ash----------	Eastern cottonwood, silver maple.
399----------------- Readlyn	Gray dogwood, silky dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
407B---------------- Schley	Gray dogwood, silky dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
408B, 408C---------- Olin	Redosier dogwood, gray dogwood.	Bloodtwig dogwood, Tatarian honeysuckle, Siberian dogwood.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Silver maple.
412C---------------- Sogn	Lilac, indian-currant coral-berry, Siberian peashrub.	Autumn-olive, eastern redcedar, Amur honeysuckle, Tatarian honey-suckle.	Eastern white pine, Austrian pine.	---	---
471----------------- Oran	Silky dogwood, gray dogwood.	Redosier dogwood, Tatarian honeysuckle, Amur honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of-- <8	8-15	16-25	26-35	>35
485. Spillville	Gray dogwood, silky dogwood.	Redosier dogwood, Tatarian honeysuckle, lilac.	Amur maple, eastern redcedar.	Common hackberry, red pine, Norway spruce.	Eastern cottonwood, silver maple.
499B, 499D, 499F. Nordness	Lilac, indiancurrant coralberry, Siberian peashrub.	Autumn-olive, eastern redcedar, Amur honeysuckle, Tatarian honeysuckle.	Eastern white pine, Austrain pine.	---	---
585*: Spillville	Gray dogwood, silky dogwood.	Redosier dogwood, Tatarian honeysuckle, lilac.	Amur maple, eastern redcedar.	Common hackberry, red pine, Norway spruce.	Eastern cottonwood, silver maple.
Coland	Common ninebark, indiancurrant coralberry.	Redosier dogwood, Tatarian honeysuckle, silky dogwood, Zabel honeysuckle.	White spruce, northern white-cedar, Amur maple.	Green ash	Eastern cottonwood, silver maple.
663B, 663C2. Seaton	Redosier dogwood, gray dogwood.	Silky dogwood, autumn-olive, Amur honeysuckle, lilac.	Amur maple, eastern redcedar.	Eastern white pine, Norway spruce, red pine.	Eastern cottonwood.
663F. Seaton					
725. Hayfield	Gray dogwood, silky dogwood.	Tatarian honeysuckle, lilac, Siberian crabapple, American plum.	Eastern redcedar, bur oak, northern white-cedar, Russian-olive, common hackberry, white spruce.	Green ash	Silver maple.
761. Franklin	Gray dogwood, silky dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
776, 776C. Lilah	Siberian peashrub	Lilac, Washington hawthorn, Tatarian honeysuckle, eastern redcedar, Amur honeysuckle.	Austrian pine, jack pine, red pine.	Eastern white pine	---
777. Wapsie	Siberian peashrub	Lilac, Tatarian honeysuckle, Amur honeysuckle, eastern redcedar.	Austrian pine, red pine, jack pine.	Eastern white pine.	---
782B. Donnan	Gray dogwood, silky dogwood.	Redosier dogwood, Tatarian honeysuckle.	Blue spruce, eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry, eastern white pine.	Silver maple.
798B. Protivin	Redosier dogwood, gray dogwood.	Silky dogwood, Tatarian honeysuckle, Amur honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
807B Schley Variant	Gray dogwood, silky dogwood.	Redosier dogwood, American plum, Tatarian honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
809B Bertram	Siberian peashrub	Amur honeysuckle, Russian-olive, lilac, eastern redcedar, Tatarian honeysuckle.	Eastern white pine, Austrian pine, red pine, jack pine.	---	---
813 Atkinson	Redosier dogwood, silky dogwood.	Tatarian honeysuckle, lilac, Amur honeysuckle, eastern redcedar.	Amur maple, white spruce.	Austrian pine, common hackberry, eastern white pine, red pine.	---
883B Cresco	Redosier dogwood, gray dogwood.	Silky dogwood, Tatarian honeysuckle, Amur honeysuckle.	Eastern redcedar, Amur maple.	Red pine, Norway spruce, common hackberry.	Eastern cottonwood, silver maple.
1585*:					
Spillville	Gray dogwood, silky dogwood.	Redosier dogwood, Tatarian honeysuckle, lilac.	Amur maple, eastern redcedar.	Common hackberry, red pine, Norway spruce.	Eastern cottonwood, silver maple.
Coland	Common ninebark, indiancurrant coralberry.	Redosier dogwood, Tatarian honeysuckle, silky dogwood, Zabel honeysuckle.	White spruce, northern white-cedar, Amur maple.	Green ash	Eastern cottonwood, silver maple.
5010*, 5030*. Pits					
5040*. Orthents					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
41 Sparta	Slight	Slight	Moderate: small stones.	Slight	Moderate: droughty.
41B Sparta	Slight	Slight	Moderate: slope, small stones.	Slight	Moderate: droughty.
41C Sparta	Slight	Slight	Severe: slope.	Slight	Moderate: droughty.
63B Chelsea	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
63C Chelsea	Slight	Slight	Severe: slope.	Slight	Moderate: droughty.
83B Kenyon	Slight	Slight	Moderate: slope.	Slight	Slight.
83C, 83C2 Kenyon	Slight	Slight	Severe: slope.	Slight	Slight.
84 Clyde	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
109B Backbone	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, depth to rock, percs slowly.	Slight	Moderate: thin layer.
110 Lamont	Slight	Slight	Slight	Slight	Slight.
110B Lamont	Slight	Slight	Moderate: slope.	Slight	Slight.
141 Watseka	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, droughty.
151, 152 Marshan	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
159 Finchford	Severe: floods.	Slight	Slight	Slight	Moderate: droughty.
159C Finchford	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
171B Bassett	Slight	Slight	Moderate: slope.	Slight	Slight.
171C2 Bassett	Slight	Slight	Severe: slope.	Slight	Slight.
175 Dickinson	Slight	Slight	Slight	Slight	Slight.
175B Dickinson	Slight	Slight	Moderate: slope.	Slight	Slight.
177 Saude	Slight	Slight	Slight	Slight	Slight.
177B Saude	Slight	Slight	Moderate: slope.	Slight	Slight.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
178 Waukee	Slight	Slight	Slight	Slight	Slight.
184 Klinger	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight	Slight.
198B Floyd	Severe: excess humus.	Severe: excess humus.	Severe: excess humus.	Severe: excess humus.	Slight.
205B, 207B Whalan	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, depth to rock, percs slowly.	Slight	Moderate: thin layer.
213B Rockton	Slight	Slight	Moderate: slope, depth to rock.	Slight	Moderate: thin layer.
214 Rockton	Slight	Slight	Slight	Slight	Moderate: thin layer.
221 Palms	Severe: ponding, floods, excess humus.	Severe: ponding, excess humus.	Severe: ponding, floods, excess humus.	Severe: ponding, excess humus.	Severe: ponding, floods, excess humus.
225, 226 Lawler	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight	Slight.
241B*:					
Burkhardt	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
Saude	Slight	Slight	Moderate: slope.	Slight	Slight.
284 Flagler	Slight	Slight	Slight	Slight	Slight.
284B Flagler	Slight	Slight	Moderate: slope.	Slight	Slight.
290 Dells	Severe: floods, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
354*. Aquolls					
377B Dinsdale	Slight	Slight	Moderate: slope.	Slight	Slight.
382 Maxfield	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
391B*:					
Clyde	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
Floyd	Severe: excess humus.	Severe: excess humus.	Severe: excess humus.	Severe: excess humus.	Slight.
398 Tripoli	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
399 Readlyn	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight	Slight.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
407B------------------ Schley	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight------------	Slight.
408B------------------ Olin	Slight----------	Slight----------	Moderate: slope.	Slight------------	Slight.
408C------------------ Olin	Slight----------	Slight----------	Severe: slope.	Slight------------	Slight.
412C------------------ Sogn	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight------------	Severe: thin layer.
471------------------- Oran	Moderate: wetness.	Moderate: wetness.	Moderate: wetness.	Slight------------	Slight.
485------------------- Spillville	Severe: floods.	Slight----------	Moderate: floods.	Slight------------	Moderate: floods.
499B------------------ Nordness	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight------------	Severe: thin layer.
499D------------------ Nordness	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Slight------------	Severe: thin layer.
499F------------------ Nordness	Severe: slope, depth to rock.	Severe: slope.	Severe: slope, depth to rock.	Moderate: slope.	Severe: slope, thin layer.
585*:					
Spillville-----------	Severe: floods.	Slight----------	Moderate: floods.	Slight------------	Moderate: floods.
Coland---------------	Severe: floods, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness, floods.
663B------------------ Seaton	Slight----------	Slight----------	Moderate: slope.	Severe: erodes easily.	Slight.
663C2----------------- Seaton	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.	Moderate: slope.
663F------------------ Seaton	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.	Severe: slope.
725------------------- Hayfield	Slight----------	Slight----------	Slight----------	Slight------------	Slight.
761------------------- Franklin	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight------------	Slight.
776------------------- Lilah	Slight----------	Slight----------	Moderate: small stones.	Slight------------	Severe: droughty.
776C------------------ Lilah	Slight----------	Slight----------	Moderate: slope, small stones.	Slight------------	Severe: droughty.
777------------------- Wapsie	Slight----------	Slight----------	Slight----------	Slight------------	Slight.
782B------------------ Donnan	Severe: percs slowly.	Severe: percs slowly.	Severe: percs slowly.	Slight------------	Slight.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails	Golf fairways
798B------------------ Protivin	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: slope, wetness, percs slowly.	Slight------------	Slight.
807B------------------ Schley Variant	Moderate: wetness.	Moderate: wetness.	Moderate: slope, wetness.	Slight------------	Moderate: droughty.
809B------------------ Bertram	Slight----------	Slight----------	Moderate: slope, depth to rock.	Slight------------	Moderate: thin layer.
813------------------- Atkinson	Slight----------	Slight----------	Slight----------	Slight------------	Slight.
883B------------------ Cresco	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight------------	Slight.
1585*:					
Spillville-----------	Severe: floods.	Moderate: floods.	Severe: floods.	Moderate: floods.	Severe: floods.
Coland---------------	Severe: floods, wetness.	Moderate: floods, wetness.	Severe: wetness, floods.	Moderate: wetness, floods.	Severe: floods.
5010*, 5030*. Pits					
5040*. Orthents					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--WILDLIFE HABITAT POTENTIALS

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
41, 41B-------------Sparta	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
41C-----------------Sparta	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
63B, 63C------------Chelsea	Poor	Fair	Fair	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.
83B-----------------Kenyon	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
83C, 83C2-----------Kenyon	Fair	Good	Good	Good	Good	Poor	Fair	Good	Good	Fair.
84------------------Clyde	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
109B----------------Backbone	Fair	Fair	Good	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
110, 110B-----------Lamont	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
141-----------------Watseka	Fair	Fair	Good	Good	Good	Fair	Poor	Fair	Good	Poor.
151, 152------------Marshan	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
159, 159C-----------Finchford	Poor	Poor	Fair	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
171B----------------Bassett	Fair	Good	Good	Good	Good	Poor	Fair	Good	Good	Fair.
171C2---------------Bassett	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
175, 175B-----------Dickinson	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
177, 177B-----------Saude	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
178-----------------Waukee	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
184-----------------Klinger	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
198B----------------Floyd	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good.
205B, 207B----------Whalan	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
213B, 214-----------Rockton	Fair	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
221-----------------Palms	Good	Poor	Poor	Poor	Poor	Good	Good	Fair	Poor	Good.

TABLE 10.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Hardwood trees	Conif-erous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
225, 226 Lawler	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
241B*:										
Burkhardt	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
Saude	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
284, 284B Flagler	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
290 Dells	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
354*. Aquolls										
377B Dinsdale	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
382 Maxfield	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
391B*:										
Clyde	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
Floyd	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good.
398 Tripoli	Good	Good	Good	Fair	Poor	Good	Good	Good	Fair	Good.
399 Readlyn	Good	Good	Good	Fair	Fair	Fair	Fair	Good	Fair	Fair.
407B Schley	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good.
408B Olin	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
408C Olin	Fair	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
412C Sogn	Very poor.	Very poor.	Poor	---	---	Very poor.	Very poor.	Very poor.	---	Very poor.
471 Oran	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
485 Spillville	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
499B, 499D Nordness	Poor	Poor	Poor	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
499F Nordness	Very poor.	Poor	Poor	Poor	Poor	Very poor.	Very poor.	Poor	Poor	Very poor.
585*:										
Spillville	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements							Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Hardwood trees	Coniferous plants	Wetland plants	Shallow water areas	Openland wildlife	Woodland wildlife	Wetland wildlife
585*:										
Coland	Good	Good	Good	Fair	Fair	Good	Good	Good	Fair	Good.
663B, 663C2 Seaton	Fair	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
663F Seaton	Poor	Fair	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.
725 Hayfield	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor.
761 Franklin	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
776 Lilah	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
776C Lilah	Poor	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Poor	Fair	Very poor.
777 Wapsie	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.
782B Donnan	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
798B Protivin	Good	Fair	Good	Fair	Fair	Good	Good	Fair	Fair	Good.
807B Schley Variant	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good.
809B Bertram	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.
813 Atkinson	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.
883B Cresco	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
1585*:										
Spillville	Good	Good	Good	Good	Good	Fair	Fair	Good	Good	Fair.
Coland	Poor	Fair	Fair	Poor	Poor	Good	Good	Poor	Poor	Good.
5010*, 5030*. Pits										
5040*. Orthents										

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
41, 41B: Sparta	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
41C: Sparta	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
63B: Chelsea	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Moderate: droughty.
63C: Chelsea	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
83B: Kenyon	Slight	Slight	Slight	Slight	Severe: low strength.	Slight.
83C, 83C2: Kenyon	Slight	Slight	Slight	Moderate: slope.	Severe: low strength.	Slight.
84: Clyde	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
109B: Backbone	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: depth to rock, slope.	Moderate: depth to rock.	Moderate: thin layer.
110, 110B: Lamont	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.	Slight.
141: Watseka	Severe: wetness, cutbanks cave.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Moderate: wetness, frost action.	Moderate: wetness, droughty.
151, 152: Marshan	Severe: cutbanks cave, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
159: Finchford	Severe: cutbanks cave.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods.	Moderate: droughty.
159C: Finchford	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight	Moderate: droughty.
171B: Bassett	Slight	Slight	Slight	Slight	Moderate: low strength, frost action.	Slight.
171C2: Bassett	Slight	Slight	Slight	Moderate: slope.	Moderate: low strength, frost action.	Slight.
175, 175B: Dickinson	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.	Slight.
177, 177B: Saude	Severe: cutbanks cave.	Slight	Slight	Slight	Slight	Slight.
178: Waukee	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: low strength.	Slight.
184: Klinger	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: frost action, low strength.	Slight.
198B: Floyd	Severe: cutbanks cave, excess humus, wetness.	Severe: low strength.	Severe: wetness.	Severe: low strength.	Severe: low strength, frost action.	Slight.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
205B, 207B-------- Whalan	Moderate: depth to rock, too clayey.	Slight---------	Moderate: depth to rock.	Slight---------	Severe: low strength.	Moderate: thin layer.
213B-------------- Rockton	Moderate: depth to rock, too clayey.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Moderate: low strength, frost action.	Moderate: thin layer.
214--------------- Rockton	Moderate: depth to rock, too clayey.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell.	Moderate: low strength, frost action.	Moderate: thin layer.
221--------------- Palms	Severe: excess humus, ponding.	Severe: ponding, low strength, floods.	Severe: ponding, low strength, floods.	Severe: ponding, floods, low strength.	Severe: ponding, floods, frost action.	Severe: ponding, floods, excess humus.
225, 226---------- Lawler	Severe: wetness, cutbanks cave.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Slight.
241B*:						
Burkhardt---------	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: droughty.
Saude------------	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Slight.
284, 284B--------- Flagler	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Slight.
290--------------- Dells	Severe: cutbanks cave, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: low strength, frost action.	Moderate: wetness.
354*. Aquolls						
377B-------------- Dinsdale	Slight---------	Moderate: shrink-swell.	Slight---------	Moderate: shrink-swell.	Severe: frost action, low strength.	Slight.
382--------------- Maxfield	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: wetness.	Severe: wetness, shrink-swell.	Severe: low strength, frost action, shrink-swell.	Moderate: wetness.
391B*:						
Clyde------------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: low strength, frost action.	Moderate: wetness.
Floyd------------	Severe: cutbanks cave, excess humus, wetness.	Severe: low strength.	Severe: wetness.	Severe: low strength.	Severe: low strength, frost action.	Slight.
398--------------- Tripoli	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: frost action.	Moderate: wetness.
399--------------- Readlyn	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action, low strength.	Slight.
407B-------------- Schley	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Slight.
408B-------------- Olin	Slight---------	Slight---------	Slight---------	Slight---------	Moderate: frost action.	Slight.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
408C---------------- Olin	Slight---------	Slight---------	Slight---------	Moderate: slope.	Moderate: frost action.	Slight.
412C---------------- Sogn	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: thin layer.
471----------------- Oran	Severe: wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Slight.
485----------------- Spillville	Moderate: floods, wetness.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength, floods.	Moderate: floods.
499B---------------- Nordness	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: thin layer.
499D---------------- Nordness	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: thin layer.
499F---------------- Nordness	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope, thin layer.
585*:						
Spillville--------	Moderate: floods, wetness.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength, floods.	Moderate: floods.
Coland------------	Severe: wetness.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, low strength, frost action.	Moderate: wetness, floods.
663B---------------- Seaton	Slight---------	Slight---------	Slight---------	Moderate: slope.	Severe: low strength, frost action.	Slight.
663C2--------------- Seaton	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength, frost action.	Moderate: slope.
663F---------------- Seaton	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope, frost action.	Severe: slope.
725----------------- Hayfield	Severe: cutbanks cave.	Slight---------	Moderate: wetness.	Slight---------	Severe: frost action.	Slight.
761----------------- Franklin	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: frost action, low strength.	Slight.
776----------------- Lilah	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Severe: droughty.
776C---------------- Lilah	Severe: cutbanks cave.	Slight---------	Slight---------	Moderate: slope.	Slight---------	Severe: droughty.
777----------------- Wapsie	Severe: cutbanks cave.	Slight---------	Slight---------	Slight---------	Slight---------	Slight.
782B---------------- Donnan	Moderate: wetness, too clayey.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell, frost action.	Slight.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
798B-----------------Protivin	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: wetness.	Moderate: wetness, shrink-swell.	Severe: frost action, low strength.	Slight.
807B-----------------Schley Variant	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Severe: frost action.	Moderate: droughty.
809B-----------------Bertram	Severe: depth to rock.	Moderate: depth to rock.	Severe: depth to rock.	Moderate: slope, depth to rock.	Moderate: depth to rock, frost action.	Moderate: thin layer.
813-----------------Atkinson	Moderate: depth to rock.	Slight---------	Moderate: depth to rock.	Slight---------	Severe: low strength.	Slight.
883B-----------------Cresco	Slight---------	Moderate: shrink-swell.	Moderate: shrink-swell, wetness.	Moderate: shrink-swell.	Severe: low strength, frost action.	Slight.
1585*:						
Spillville--------	Moderate: floods, wetness.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: low strength, floods.	Severe: floods.
Coland------------	Severe: wetness.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, low strength, frost action.	Severe: floods.
5010*, 5030*. Pits						
5040*. Orthents						

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
41, 41B Sparta	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
41C Sparta	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
63B Chelsea	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
63C Chelsea	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
83B Kenyon	Moderate: percs slowly.	Moderate: slope, seepage.	Slight	Slight	Good.
83C, 83C2 Kenyon	Moderate: percs slowly.	Severe: slope.	Slight	Slight	Good.
84 Clyde	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
109B Backbone	Severe: depth to rock.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Severe: seepage, depth to rock.	Poor: area reclaim.
110, 110B Lamont	Severe: poor filter.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
141 Watseka	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: wetness, seepage, too sandy.	Severe: seepage, wetness.	Poor: too sandy, wetness, seepage.
151, 152 Marshan	Severe: wetness, poor filter.	Severe: wetness, seepage.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
159, 159C Finchford	Severe: poor filter.	Severe: seepage.	Severe: too sandy, seepage.	Severe: seepage.	Poor: too sandy, seepage.
171B Bassett	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
171C2 Bassett	Moderate: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
175, 175B Dickinson	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
177, 177B Saude	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage, small stones.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
178----------------- Waukee	Severe: poor filter.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: too sandy, seepage.
184----------------- Klinger	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
198B---------------- Floyd	Severe: wetness.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Fair: too clayey, wetness.
205B, 207B---------- Whalan	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
213B, 214----------- Rockton	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
221----------------- Palms	Severe: floods, subsides, ponding.	Severe: seepage, excess humus, ponding.	Severe: ponding, floods, excess humus.	Severe: ponding, floods, seepage.	Poor: ponding, excess humus.
225, 226------------ Lawler	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
241B*:					
Burkhardt----------	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Saude--------------	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage, small stones.
284, 284B----------- Flagler	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage.
290----------------- Dells	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, wetness.
354*. Aquolls					
377B---------------- Dinsdale	Moderate: percs slowly.	Moderate: seepage, slope.	Slight-----------	Slight-----------	Good.
382----------------- Maxfield	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
391B*:					
Clyde--------------	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.
Floyd--------------	Severe: wetness.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Fair: too clayey, wetness.
398----------------- Tripoli	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Poor: wetness.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
399 Readlyn	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
407B Schley	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: wetness.
408B Olin	Slight	Moderate: slope, seepage.	Slight	Slight	Good.
408C Olin	Slight	Severe: slope.	Slight	Slight	Good.
412C Sogn	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
471 Oran	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
485 Spillville	Severe: wetness, floods.	Severe: wetness, seepage, floods.	Severe: wetness, seepage, floods.	Severe: wetness, floods.	Fair: wetness.
499B Nordness	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
499D Nordness	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
499F Nordness	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Poor: area reclaim, slope.
585*:					
Spillville	Severe: wetness, floods.	Severe: wetness, seepage, floods.	Severe: wetness, seepage, floods.	Severe: wetness, floods.	Fair: wetness.
Coland	Severe: floods, wetness.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Severe: floods, wetness.	Poor: wetness, hard to pack.
663B Seaton	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
663C2 Seaton	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Fair: slope.
663F Seaton	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
725 Hayfield	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: seepage, wetness, too sandy.	Severe: seepage, wetness.	Poor: seepage, too sandy, small stones.
761 Franklin	Severe: wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
776, 776C------------ Lilah	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Fair: too sandy.
777------------------ Wapsie	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
782B----------------- Donnan	Severe: percs slowly, wetness.	Moderate: slope.	Severe: too clayey.	Moderate: wetness.	Poor: too clayey.
798B----------------- Protivin	Severe: percs slowly, wetness.	Severe: wetness.	Severe: wetness.	Severe: wetness.	Fair: too clayey, wetness.
807B----------------- Schley Variant	Severe: wetness, poor filter.	Severe: seepage, wetness.	Severe: wetness.	Severe: seepage, wetness.	Poor: seepage.
809B----------------- Bertram	Severe: depth to rock.	Severe: depth to rock, seepage.	Severe: depth to rock.	Severe: seepage, depth to rock.	Poor: area reclaim.
813------------------ Atkinson	Severe: depth to rock, percs slowly.	Moderate: depth to rock, seepage.	Severe: depth to rock.	Moderate: depth to rock.	Fair: area reclaim.
883B----------------- Cresco	Severe: percs slowly, wetness.	Moderate: slope.	Moderate: wetness.	Slight-----------	Fair: too clayey, wetness.
1585*:					
Spillville----------	Severe: wetness, floods.	Severe: wetness, seepage, floods.	Severe: wetness, seepage, floods.	Severe: wetness, floods.	Fair: wetness.
Coland--------------	Severe: floods, wetness.	Severe: floods, wetness, seepage.	Severe: floods, wetness, seepage.	Severe: floods, wetness.	Poor: wetness, hard to pack.
5010*, 5030*. Pits					
5040*. Orthents					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," "probable," and "improbable." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
41, 41B, 41C------- Sparta	Good-----------	Probable---------	Improbable: too sandy.	Fair: too sandy.
63B, 63C---------- Chelsea	Good-----------	Probable---------	Improbable: too sandy.	Fair: too sandy.
83B, 83C, 83C2------- Kenyon	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
84--------------- Clyde	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
109B-------------- Backbone	Poor: thin layer, area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim.
110, 110B---------- Lamont	Good-----------	Probable---------	Improbable: too sandy.	Good.
141--------------- Watseka	Fair: wetness.	Probable---------	Improbable: too sandy.	Fair: too sandy.
151, 152---------- Marshan	Fair: wetness.	Probable---------	Probable---------	Fair: area reclaim, thin layer.
159, 159C---------- Finchford	Good-----------	Probable---------	Improbable: too sandy.	Fair: too sandy.
171B, 171C2--------- Bassett	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
175, 175B---------- Dickinson	Good-----------	Probable---------	Improbable: too sandy.	Good.
177, 177B---------- Saude	Good-----------	Probable---------	Probable---------	Good.
178--------------- Waukee	Good-----------	Probable---------	Improbable: too sandy.	Good.
184--------------- Klinger	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
198B-------------- Floyd	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
205B, 207B--------- Whalan	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones.
213B, 214---------- Rockton	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones.
221--------------- Palms	Poor: wetness.	Improbable: excess humus, excess fines.	Improbable: excess humus, excess fines.	Poor: wetness, excess humus.
225, 226---------- Lawler	Fair: wetness.	Probable---------	Probable---------	Poor: area reclaim.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
241B*:				
Burkhardt	Good	Probable	Probable	Poor: small stones, area reclaim.
Saude	Good	Probable	Probable	Good.
284, 284B Flagler	Good	Probable	Probable	Fair: small stones, area reclaim, thin layer.
290 Dells	Fair: wetness.	Probable	Improbable: too sandy.	Fair: thin layer.
354*. Aquolls				
377B Dinsdale	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
382 Maxfield	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim.
391B*:				
Clyde	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Floyd	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
398 Tripoli	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
399 Readlyn	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
407B Schley	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
408B, 408C Olin	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
412C Sogn	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
471 Oran	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
485 Spillville	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
499B Nordness	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
499D Nordness	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
499F Nordness	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
585*:				
Spillville	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Coland	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
663B Seaton	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
663C2 Seaton	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope.
663F Seaton	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
725 Hayfield	Fair: wetness.	Probable	Improbable: too sandy.	Poor: area reclaim.
761 Franklin	Fair: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
776, 776C Lilah	Good	Probable	Probable	Poor: area reclaim.
777 Wapsie	Good	Probable	Probable	Fair: small stones, area reclaim, thin layer.
782B Donnan	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
798B Protivin	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
807B Schley Variant	Fair: wetness.	Improbable: thin layer.	Improbable: too sandy.	Fair: thin layer.
809B Bertram	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim.
813 Atkinson	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
883B Cresco	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
1585*:				
Spillville	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Coland	Fair: wetness.	Improbable: excess fines.	Improbable: excess fines.	Good.
5010*, 5030*. Pits				
5040*. Orthents				

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
41, 41B, 41C: Sparta	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
63B, 63C: Chelsea	Severe: seepage.	Severe: piping, seepage.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
83B, 83C, 83C2: Kenyon	Moderate: slope, seepage.	Slight	Deep to water	Slope	Favorable	Favorable.
84: Clyde	Moderate: seepage.	Severe: wetness.	Frost action	Wetness	Wetness	Wetness, erodes easily.
109B: Backbone	Severe: seepage.	Severe: thin layer.	Not needed	Depth to rock, soil blowing, slope.	Depth to rock, soil blowing.	Depth to rock.
110: Lamont	Severe: seepage.	Moderate: thin layer.	Deep to water	Soil blowing	Soil blowing	Favorable.
110B: Lamont	Severe: seepage.	Moderate: thin layer.	Deep to water	Slope, soil blowing.	Soil blowing	Favorable.
141: Watseka	Severe: seepage.	Severe: piping, seepage, wetness.	Cutbanks cave	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Wetness, droughty.
151, 152: Marshan	Severe: seepage.	Severe: seepage, piping, wetness.	Frost action, cutbanks cave.	Wetness	Wetness, too sandy.	Wetness.
159, 159C: Finchford	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
171B, 171C2: Bassett	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope	Favorable	Favorable.
175: Dickinson	Severe: seepage.	Severe: seepage.	Deep to water	Soil blowing	Soil blowing, too sandy.	Favorable.
175B: Dickinson	Severe: seepage.	Severe: seepage.	Deep to water	Soil blowing, slope.	Soil blowing, too sandy.	Favorable.
177: Saude	Severe: seepage.	Severe: seepage.	Deep to water	Favorable	Too sandy	Favorable.
177B: Saude	Severe: seepage.	Severe: seepage.	Deep to water	Slope	Too sandy	Favorable.
178: Waukee	Severe: seepage.	Severe: seepage.	Deep to water	Favorable	Too sandy	Favorable.
184: Klinger	Moderate: seepage.	Moderate: wetness, piping.	Frost action	Wetness	Wetness, erodes easily.	Erodes easily.
198B: Floyd	Severe: seepage.	Moderate: piping, wetness.	Frost action	Wetness	Wetness	Favorable.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
205B, 207B Whalan	Moderate: seepage, depth to rock, slope.	Severe: thin layer.	Deep to water	Percs slowly, depth to rock, slope.	Depth to rock	Depth to rock, percs slowly.
213B Rockton	Moderate: seepage, depth to rock, slope.	Severe: thin layer.	Deep to water	Depth to rock, slope.	Depth to rock	Depth to rock.
214 Rockton	Moderate: seepage, depth to rock.	Severe: thin layer.	Deep to water	Depth to rock	Depth to rock	Depth to rock.
221 Palms	Severe: seepage.	Severe: excess humus, ponding.	Floods, ponding, subsides.	Ponding, soil blowing, floods.	Ponding, soil blowing.	Wetness.
225, 226 Lawler	Severe: seepage.	Severe: seepage.	Frost action, cutbanks cave.	Wetness	Wetness, too sandy.	Favorable.
241B*:						
Burkhardt	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, soil blowing, slope.	Too sandy, soil blowing.	Droughty.
Saude	Severe: seepage.	Severe: seepage.	Deep to water	Slope	Too sandy	Favorable.
284 Flagler	Severe: seepage.	Severe: seepage.	Deep to water	Soil blowing	Too sandy, soil blowing.	Favorable.
284B Flagler	Severe: seepage.	Severe: seepage.	Deep to water	Soil blowing, slope.	Too sandy, soil blowing.	Favorable.
290 Dells	Severe: seepage.	Severe: seepage, piping, wetness.	Frost action, cutbanks cave.	Wetness, erodes easily.	Erodes easily, wetness, too sandy.	Wetness, erodes easily.
354*. Aquolls						
377B Dinsdale	Moderate: slope, seepage.	Slight	Deep to water	Slope	Erodes easily	Erodes easily.
382 Maxfield	Moderate: seepage.	Severe: wetness.	Frost action	Wetness, rooting depth.	Wetness	Wetness, rooting depth.
391B*:						
Clyde	Moderate: seepage.	Severe: wetness.	Frost action	Wetness	Wetness	Wetness, erodes easily.
Floyd	Severe: seepage.	Moderate: piping, wetness.	Frost action	Wetness	Wetness	Favorable.
398 Tripoli	Moderate: seepage.	Severe: wetness.	Frost action	Wetness, rooting depth.	Wetness	Wetness, rooting depth.
399 Readlyn	Moderate: seepage.	Moderate: wetness.	Frost action	Wetness	Wetness	Favorable.
407B Schley	Moderate: seepage.	Moderate: wetness.	Frost action	Wetness	Wetness	Favorable.
408B, 408C Olin	Moderate: slope, seepage.	Slight	Deep to water	Soil blowing, slope.	Soil blowing	Favorable.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
412C Sogn	Severe: depth to rock.	Slight	Deep to water	Depth to rock, slope.	Depth to rock	Depth to rock.
471 Oran	Moderate: seepage.	Moderate: piping, wetness.	Frost action	Wetness	Wetness	Favorable.
485 Spillville	Moderate: seepage.	Moderate: piping, wetness.	Deep to water	Floods	Favorable	Favorable.
499B Nordness	Severe: depth to rock.	Severe: thin layer.	Deep to water	Droughty, slope, depth to rock.	Depth to rock	Depth to rock.
499D, 499F Nordness	Severe: slope, depth to rock.	Severe: thin layer.	Deep to water	Droughty, slope, depth to rock.	Slope, depth to rock, erodes easily.	Slope, erodes easily, droughty.
585*:						
Spillville	Moderate: seepage.	Moderate: piping, wetness.	Deep to water	Floods	Favorable	Favorable.
Coland	Moderate: seepage.	Severe: wetness.	Floods, frost action.	Wetness, floods.	Wetness	Wetness.
663B Seaton	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.
663C2, 663F Seaton	Severe: slope.	Moderate: piping.	Deep to water	Slope, erodes easily.	Slope, erodes easily.	Slope, erodes easily.
725 Hayfield	Severe: seepage.	Severe: seepage, piping.	Frost action, cutbanks cave.	Wetness	Wetness, too sandy.	Favorable.
761 Franklin	Moderate: seepage.	Moderate: wetness, piping.	Frost action	Wetness	Erodes easily, wetness.	Erodes easily.
776 Lilah	Severe: seepage.	Severe: seepage.	Not needed	Droughty, soil blowing.	Too sandy, soil blowing.	Droughty.
776C Lilah	Severe: seepage.	Severe: seepage.	Not needed	Droughty, soil blowing, slope.	Too sandy, soil blowing.	Droughty.
777 Wapsie	Severe: seepage.	Severe: seepage.	Deep to water	Rooting depth	Too sandy	Rooting depth.
782B Donnan	Moderate: slope.	Severe: hard to pack.	Percs slowly, frost action, slope.	Wetness, percs slowly, slope.	Wetness, percs slowly.	Percs slowly.
798B Protivin	Slight	Moderate: wetness.	Frost action	Wetness	Wetness, erodes easily.	Erodes easily.
807B Schley Variant	Severe: seepage.	Severe: seepage, piping.	Frost action, cutbanks cave.	Wetness, droughty, soil blowing.	Wetness, too sandy, soil blowing.	Droughty.
809B Bertram	Severe: seepage.	Severe: thin layer.	Deep to water	Depth to rock, soil blowing.	Depth to rock, soil blowing.	Depth to rock.
813 Atkinson	Moderate: seepage, depth to rock.	Moderate: thin layer, piping.	Not needed	Favorable	Favorable	Favorable.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
883B------------- Cresco	Moderate: slope.	Moderate: piping.	Not needed-----	Slope----------	Favorable------	Erodes easily.
1585*:						
Spillville--------	Moderate: seepage.	Moderate: piping, wetness.	Deep to water	Floods---------	Favorable------	Favorable.
Coland-----------	Moderate: seepage.	Severe: wetness.	Floods, frost action.	Wetness, floods.	Wetness--------	Wetness.
5010*, 5030*. Pits						
5040*. Orthents						

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--ENGINEERING INDEX PROPERTIES

[The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
41, 41B, 41C----- Sparta	0-40	Loamy fine sand	SM	A-2, A-4	0	85-100	85-100	50-95	15-50	---	NP
	40-60	Loamy fine sand, fine sand, sand.	SP-SM, SM	A-2, A-3, A-4	0	85-100	85-100	50-95	5-50	---	NP
63B, 63C--------- Chelsea	0-5	Loamy fine sand	SM, SP-SM	A-2-4	0	100	100	65-80	10-35	---	NP
	5-60	Fine sand, sand, loamy sand.	SP, SM, SP-SM	A-3, A-2-4	0	100	100	65-80	3-15	---	NP
83B, 83C, 83C2--- Kenyon	0-20	Loam------------	CL	A-6	0	100	95-100	85-95	65-75	30-40	10-20
	20-45	Loam, clay loam, sandy clay loam.	CL	A-6	0-5	90-95	85-95	80-90	50-65	30-40	10-20
	45-60	Loam------------	CL	A-6	0-5	90-95	85-95	80-90	50-65	25-35	10-20
84-------------- Clyde	0-22	Clay loam--------	OL, MH, ML, OH	A-7	0-5	95-100	95-100	80-90	55-75	45-60	15-25
	22-32	Clay loam, loam, silty clay loam.	CL, ML	A-6, A-7	0-5	95-100	90-95	75-90	50-75	30-50	10-20
	32-36	Sandy loam, loam	SM, SM-SC	A-2	2-5	80-95	75-90	50-80	15-35	15-20	NP-5
	36-70	Loam------------	CL, SC	A-6	2-5	90-95	85-90	75-90	45-65	25-35	10-20
109B------------ Backbone	0-8	Fine sandy loam	SM-SC, SC	A-2, A-4	0	100	100	75-85	15-40	15-25	5-10
	8-32	Sandy loam-------	SC, SM-SC	A-2, A-4	0-2	90-95	90-95	65-80	20-40	15-25	5-10
	32-35	Clay loam, clay	CL, CH	A-6, A-7	2-5	90-95	90-95	70-80	50-75	35-55	20-30
	35	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
110, 110B-------- Lamont	0-8	Fine sandy loam	SM-SC, SC	A-2, A-4	0	100	100	80-95	25-50	15-25	5-10
	8-36	Fine sandy loam, loamy fine sand.	SM, SM-SC	A-2, A-4	0	100	100	80-95	15-50	<25	NP-5
	36-60	Loamy fine sand, loamy sand, sand.	SM, SP-SM	A-2, A-3	0	100	100	70-90	5-25	---	NP
141-------------- Watseka	0-34	Loamy fine sand	SM, SM-SC	A-2	0	100	95-100	80-100	17-35	<25	NP-5
	34-60	Fine sand, sand, loamy fine sand.	SP, SM, SP-SM	A-3, A-2	0	90-100	90-100	60-80	3-25	<20	NP-4
151, 152--------- Marshan	0-21	Clay loam--------	CL	A-7, A-6	0	95-100	95-100	95-100	80-95	35-50	15-25
	21-26	Silty clay loam, clay loam, silt loam.	CL	A-7, A-6	0	95-100	95-100	95-100	80-95	30-50	15-30
	26-34	Loam, sandy loam	CL, CL-ML, SC, SM-SC	A-6, A-4	0	95-100	75-100	70-90	45-75	25-40	5-15
	34-60	Coarse sand, gravelly loamy sand, gravelly sandy loam.	SP, SW, SP-SM	A-1	0-3	65-95	45-95	20-45	2-5	---	NP
159, 159C-------- Finchford	0-22	Loamy sand-------	SP-SM, SM	A-2, A-3	0	85-95	70-90	50-60	5-15	---	NP
	22-35	Coarse sand, gravelly loamy sand.	SW-SM, SP-SM	A-1	0	80-90	60-75	25-40	5-10	---	NP
	35-60	Gravelly coarse sand, sand.	SW, SW-SM, SP, SP-SM	A-1	0	75-85	55-75	20-35	3-5	---	NP
171B, 171C2------ Bassett	0-14	Loam------------	CL, CL-ML	A-4, A-6	0	100	95-100	85-95	65-85	20-30	5-15
	14-36	Loam, clay loam, sandy clay loam.	CL	A-6	2-5	90-95	85-95	80-90	50-65	30-40	11-20
	36-60	Loam------------	CL	A-6	2-5	90-95	85-95	80-90	50-65	30-40	11-20
175, 175B-------- Dickinson	0-8	Fine sandy loam	SM, SC, SM-SC	A-4, A-2	0	100	100	85-95	30-50	15-30	NP-10
	8-33	Fine sandy loam, sandy loam.	SM, SC, SM-SC	A-4	0	100	100	85-95	35-50	15-30	NP-10
	33-45	Loamy sand, loamy fine sand, fine sand.	SM, SP-SM, SM-SC	A-2, A-3	0	100	100	80-95	5-20	10-20	NP-5
	45-60	Sand, loamy fine sand, fine sand.	SM, SP-SM	A-3, A-2	0	100	100	70-90	5-20	---	NP

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag-ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct					Pct	
177, 177B-------- Saude	0-16	Loam-------------	CL	A-6	0	100	90-100	70-90	50-75	25-35	10-15
	16-28	Loam, sandy loam	CL, SC, CL-ML, SM-SC	A-4, A-6	0-5	85-95	80-95	70-85	36-60	20-30	5-15
	28-60	Gravelly loamy sand, gravelly sand, sand.	SW, SM, GP, GM	A-1	2-10	50-90	50-85	20-40	3-25	---	NP
178-------------- Waukee	0-18	Loam-------------	CL	A-6	0	100	90-100	70-90	50-75	30-40	10-20
	18-33	Loam, sandy clay loam.	CL, SM-SC, SC, CL-ML	A-6, A-4	0-5	85-95	80-95	65-85	40-60	20-35	5-15
	33-60	Gravelly loamy sand, loamy coarse sand, sandy loam.	SW, SM, SP-SM, SP	A-1	2-10	60-90	60-85	20-40	3-25	---	NP
184-------------- Klinger	0-13	Silty clay loam	CL, ML	A-7	0	100	100	100	95-100	40-50	15-25
	13-25	Silty clay loam	CL	A-7	0	100	100	100	95-100	40-50	20-30
	25-60	Loam, clay loam	CL	A-6	0-5	90-95	85-90	75-85	55-65	25-35	10-20
198B------------- Floyd	0-18	Loam-------------	OL, MH, ML, OH	A-7	0	100	100	80-90	55-75	45-60	15-25
	18-28	Sandy clay loam, loam.	CL	A-6	2-8	90-95	70-80	50-70	50-65	25-35	11-20
	28-34	Sandy loam, loamy sand.	SM, SM-SC	A-2	2-5	90-95	70-80	50-70	15-35	10-20	NP-5
	34-60	Loam, clay loam, sandy clay loam.	CL	A-6	2-5	90-95	85-95	70-85	50-65	25-35	11-20
205B------------- Whalan	0-9	Silt loam--------	ML	A-4	0	100	95-100	85-95	60-90	30-40	5-10
	9-27	Clay loam, loam	CL	A-6	0	95-100	95-100	80-95	70-90	30-40	10-15
	27-36	Clay loam, clay, silty clay.	CL, CH	A-7	0-5	80-100	70-95	65-90	50-85	40-60	20-35
	36	Weathered bedrock	---	---	---	---	---	---	---	---	---
207B------------- Whalan	0-9	Silt loam--------	ML	A-4	0	100	95-100	85-95	60-90	30-40	5-10
	9-15	Clay loam, loam	CL	A-6	0	95-100	95-100	80-95	70-90	30-40	10-15
	15-28	Clay loam, clay, silty clay.	CL, CH	A-7	0-5	80-100	70-95	65-90	50-85	40-60	20-35
	28	Weathered bedrock	---	---	---	---	---	---	---	---	---
213B------------- Rockton	0-18	Loam-------------	ML, CL-ML, CL	A-4	0	90-100	90-100	85-95	50-75	25-35	5-10
	18-34	Loam, sandy clay loam, clay loam.	CL, SC	A-6, A-7	0	90-100	90-100	75-90	45-70	30-45	10-20
	34	Weathered bedrock	---	---	---	---	---	---	---	---	---
214-------------- Rockton	0-16	Loam-------------	ML, CL-ML, CL	A-4	0	90-100	90-100	85-95	50-75	25-35	5-10
	16-24	Loam, sandy clay loam, clay loam.	CL, SC	A-6, A-7	0	90-100	90-100	75-90	45-70	30-45	10-20
	24	Weathered bedrock	---	---	---	---	---	---	---	---	---
221-------------- Palms	0-45	Sapric material	Pt	---	---	---	---	---	---	---	---
	45-60	Clay loam, silty clay loam, fine sandy loam.	CL-ML, CL	A-4, A-6	0	85-100	80-100	70-95	50-90	25-40	5-20
225-------------- Lawler	0-16	Loam-------------	CL, ML	A-6, A-7	0	100	90-100	70-90	55-75	35-45	10-20
	16-30	Loam, sandy clay loam, clay loam.	CL, SC	A-6	0-5	85-95	80-95	70-85	45-65	25-40	10-20
	30-60	Stratified sandy loam to gravelly coarse sand.	SW, GP, SP, SW-SM	A-1	2-10	50-90	50-85	20-40	3-10	---	NP
226-------------- Lawler	0-16	Loam-------------	CL, ML	A-6, A-7	0	100	90-100	70-90	55-75	35-45	10-20
	16-34	Loam, sandy clay loam, clay loam.	CL, SC	A-6	0-5	85-95	80-95	70-85	45-65	25-40	10-20
	34-60	Stratified sandy loam to gravelly coarse sand.	SW, GP, SP, SW-SM	A-1	2-10	50-90	50-85	20-40	3-10	---	NP

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
241B*:											
Burkhardt	0-13	Sandy loam	SM, SM-SC	A-2, A-4	0	95-100	95-100	60-70	25-40	<20	2-7
	13-18	Sandy loam, loam	SM, ML, SC, CL	A-2, A-4	0	95-100	85-100	60-95	25-60	15-30	2-10
	18-60	Stratified sand to gravel.	SP, SP-SM, GP, GP-GM	A-1	0	50-75	45-75	20-35	1-5	---	NP
Saude	0-14	Loam	CL	A-6	0	100	90-100	70-90	50-75	25-35	10-15
	14-33	Loam, sandy loam	CL, SC, CL-ML, SM-SC	A-4, A-6	0-5	85-95	80-95	70-85	36-60	20-30	5-15
	33-60	Loamy sand, gravelly coarse sand, sand.	SW, SM, GP, GM	A-1	2-10	50-90	50-85	20-40	3-25	---	NP
284, 284B Flagler	0-19	Sandy loam	SC, SM-SC	A-2, A-4	0	95-100	90-95	60-70	25-40	15-25	5-10
	19-25	Sandy loam	SC, SM-SC	A-2, A-4	0	95-100	90-95	50-70	25-40	15-25	5-10
	25-60	Loamy sand, sand, coarse sand.	SP-SM, SW, SP, SW-SM	A-1	0-5	70-90	70-85	20-40	3-12	---	NP
290 Dells	0-12	Silt loam	CL	A-4	0	100	100	95-100	90-95	25-30	7-10
	12-27	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	90-100	85-95	30-45	11-20
	27-34	Loam, sandy loam, sandy clay loam.	CL, CL-ML, SC, SM-SC	A-4, A-6	0	100	100	60-100	40-75	20-35	4-14
	34-60	Sand, loamy sand	SP-SM, SM, SP	A-3, A-2, A-1	0	90-100	90-100	45-100	0-15	---	NP
354*. Aquolls											
377B Dinsdale	0-15	Silt loam	ML, CL	A-6, A-7	0	100	100	100	95-100	30-50	10-20
	15-25	Silty clay loam	CL	A-7	0	100	100	100	95-100	40-50	15-25
	25-60	Loam, clay loam, sandy clay loam.	CL	A-6	0-5	90-95	85-90	75-85	55-65	25-35	10-20
382 Maxfield	0-18	Silty clay loam	CL, CH	A-7	0	100	100	100	95-100	45-55	20-30
	18-30	Silty clay loam, silt loam.	CH, CL	A-7	0	100	100	100	95-100	45-55	25-35
	30-60	Loam	CL	A-6	0-5	90-95	85-90	75-85	55-65	25-35	10-20
391B*:											
Clyde	0-22	Clay loam	OL, MH, ML, OH	A-7	0-5	95-100	95-100	80-90	55-75	45-60	15-25
	22-32	Clay loam, loam, silty clay loam.	CL, ML	A-6, A-7	0-5	95-100	90-95	75-90	50-75	30-50	10-20
	32-36	Sandy loam, loam	SM, SM-SC	A-2	2-5	80-95	75-90	50-80	15-35	15-20	NP-5
	36-70	Loam	CL, SC	A-6	2-5	90-95	85-90	75-90	45-65	25-35	10-20
Floyd	0-18	Loam	OL, MH, ML, OH	A-7	0	100	100	80-90	55-75	45-60	15-25
	18-28	Sandy clay loam, loam.	CL	A-6	2-8	90-95	70-80	50-70	50-65	25-35	11-20
	28-34	Sandy loam, loamy sand.	SM, SM-SC	A-2	2-5	90-95	70-80	50-70	15-35	10-20	NP-5
	34-60	Loam, clay loam, sandy clay loam.	CL	A-6	2-5	90-95	85-95	70-85	50-65	25-35	11-20
398 Tripoli	0-19	Clay loam	CL	A-6, A-7	0	100	100	85-95	55-75	35-45	15-25
	19-35	Clay loam, loam	CL	A-6	2-5	90-95	85-90	75-85	55-65	30-40	11-20
	35-60	Loam, sandy clay loam, clay loam.	CL, SC	A-6	2-5	90-95	85-90	75-85	45-65	30-40	11-20
399 Readlyn	0-22	Loam	CL	A-6	0	100	100	85-95	55-75	30-40	15-25
	22-50	Loam, clay loam, sandy clay loam.	CL, SC	A-6	2-5	90-95	85-90	75-85	45-65	30-40	10-20
	50-60	Loam, sandy clay loam.	CL, SC	A-6	2-5	90-95	85-90	75-85	45-65	25-35	10-20

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
407B------------- Schley	0-13	Loam------------	CL, CL-ML	A-4, A-6	0	100	95-100	80-90	55-75	25-40	5-15
	13-34	Loam, sandy loam, silty clay loam.	CL, SC, SM-SC, CL-ML	A-2, A-4	2-8	90-95	70-80	50-70	20-60	20-30	5-10
	34-60	Loam, sandy clay loam, clay loam.	CL	A-6	2-5	90-95	85-95	70-85	50-65	25-40	10-20
408B, 408C-------- Olin	0-29	Fine sandy loam	SM-SC, SC	A-2, A-4	0	100	95-100	85-95	30-50	20-30	5-10
	29-60	Loam, clay loam, sandy clay loam.	CL, SC	A-6	2-5	90-95	85-95	80-90	45-65	25-35	10-20
412C------------- Sogn	0-18	Loam-------------	CL	A-6	0-10	85-100	85-100	85-100	70-95	25-40	11-23
	18	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
471-------------- Oran	0-16	Loam-------------	CL, CL-ML	A-4, A-6	0	100	100	85-95	55-75	25-35	5-15
	16-39	Loam, clay loam, sandy clay loam.	CL	A-6	2-5	90-95	85-90	75-85	55-65	30-40	10-20
	39-60	Loam-------------	CL	A-6	2-5	90-95	85-90	75-85	55-65	30-40	10-20
485-------------- Spillville	0-40	Loam-------------	CL	A-6	0	100	95-100	85-95	60-80	25-40	10-20
	40-60	Loam, sandy loam, loamy sand.	CL, CL-ML, SM-SC, SC	A-6, A-4	0	100	95-100	80-90	35-75	20-40	5-15
499B, 499D, 499F- Nordness	0-12	Loam, clay loam	CL, CL-ML	A-4	0	100	100	90-100	70-90	20-30	5-10
	12-16	Silty clay loam	CL, CH	A-7	2-10	85-95	80-90	70-85	65-85	45-60	30-40
	16	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
585*:											
Spillville------	0-40	Loam-------------	CL	A-6	0	100	95-100	85-95	60-80	25-40	10-20
	40-60	Sandy clay loam, loam, sandy loam.	CL, CL-ML, SM-SC, SC	A-6, A-4	0	100	95-100	80-90	35-75	20-40	5-15
Coland----------	0-48	Clay loam--------	CL, CH	A-7	0	100	100	95-100	65-80	45-55	20-30
	48-60	Clay loam, silty clay loam.	CL, CH	A-7	0	100	100	95-100	65-80	45-55	20-30
663B, 663C2, 663F------------ Seaton	0-6	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	100	95-100	24-35	6-16
	6-60	Silt loam--------	CL	A-6, A-4	0	100	100	100	90-100	28-40	9-21
725-------------- Hayfield	0-12	Loam-------------	ML, CL	A-6, A-4	0	100	100	90-98	70-90	25-40	3-15
	12-25	Loam, silt loam, clay loam.	ML, CL	A-4, A-6	0	98-100	95-100	70-90	65-80	25-40	3-15
	25-60	Sandy loam, loamy sand.	SP, SP-SM	A-2, A-3	0-3	85-100	50-98	20-45	0-10	---	NP
761-------------- Franklin	0-14	Silt loam--------	CL-ML, CL	A-4, A-6	0	100	100	100	95-100	25-35	5-15
	14-19	Silty clay loam	CL	A-7	0	100	100	100	95-100	40-50	20-30
	19-60	Loam, clay loam, sandy clay loam.	CL	A-6	2-5	95-100	90-95	75-85	55-65	25-35	10-20
776, 776C-------- Lilah	0-13	Sandy loam-------	SM-SC, SC	A-2, A-4	0-5	90-95	80-90	60-70	25-40	15-25	5-10
	13-21	Sandy loam, gravelly loamy sand.	SW, SW-SM, SP, SP-SM	A-1-b	0-10	75-85	60-80	30-50	3-12	---	NP
	21-60	Loamy sand, sand, gravelly loamy sand.	GP, SP, GP-GM, SP-SM	A-1-b	0-10	50-60	40-50	30-50	3-12	---	NP

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
777---------------- Wapsie	0-10	Loam---------------	CL, ML, CL-ML	A-4	0	100	90-100	70-90	50-75	25-35	5-10
	10-27	Loam, sandy loam	CL, SC, CL-ML, SM-SC	A-4, A-6	0	85-95	80-95	70-85	40-60	20-35	5-15
	27-60	Gravelly loamy sand, gravelly sand.	SW, SM, SP, SP-SM	A-1	0	60-90	60-85	20-40	3-25	---	NP
782B-------------- Donnan	0-21	Loam---------------	CL, ML	A-4, A-6	0	100	100	85-95	65-80	30-40	5-15
	21-30	Clay loam, silty clay loam.	CL	A-6, A-7	0-5	95-100	90-95	80-90	60-75	35-50	15-30
	30-39	Clay, silty clay	CH	A-7	0-5	95-100	90-95	80-90	60-75	55-70	30-40
	39-60	Clay loam---------	CL	A-6, A-7	2-5	95-100	85-95	80-90	55-75	35-45	15-25
798B-------------- Protivin	0-14	Loam---------------	MH, OH, CL, ML	A-7	0	100	100	85-95	60-75	45-55	15-20
	14-28	Loam, clay loam	CL	A-6	2-5	90-95	85-90	75-85	55-65	35-40	15-20
	28-60	Clay loam---------	CL	A-6	2-5	90-95	85-90	75-85	55-65	30-40	15-25
807B-------------- Schley Variant	0-8	Sandy loam---------	SC, SM, SM-SC	A-2, A-4	0	100	100	80-95	30-50	15-30	3-10
	8-37	Sandy loam, loamy sand, loamy fine sand.	SM, SP-SM	A-2	0	100	100	80-95	10-25	<20	NP-3
	37-50	Fine sand, loamy fine sand, sand.	SM, SP-SM	A-2, A-3	0	100	100	65-75	5-15	---	NP
	50-60	Loam---------------	CL	A-6	2-5	95-100	85-95	80-90	50-65	25-40	10-20
809B-------------- Bertram	0-18	Fine sandy loam	SM-SC, SC, SM	A-2, A-4	0	100	95-100	85-95	30-50	25-35	5-10
	18-36	Sandy loam--------	SM-SC, SC	A-2, A-4	0	100	95-100	80-90	25-40	15-25	5-10
	36-39	Sandy clay loam, clay loam.	SC, CL	A-6, A-7	0	85-95	80-90	70-80	45-65	35-45	20-30
	39	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
813---------------- Atkinson	0-20	Loam---------------	CL	A-6	0	100	95-100	85-95	55-75	25-35	10-20
	20-43	Loam, clay loam, sandy clay loam.	CL	A-6	2-5	90-95	80-95	80-90	50-65	30-40	10-20
	43	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
883B-------------- Cresco	0-16	Loam---------------	OL, ML	A-6, A-7	0	100	100	90-100	70-80	35-50	10-20
	16-57	Loam, clay loam	CL	A-6	2-5	90-95	85-90	75-85	55-70	30-40	10-20
	57-60	Clay loam---------	CL	A-6	2-5	95-100	85-95	80-90	55-70	30-40	10-20
1585*: Spillville-------	0-40	Loam---------------	CL	A-6	0	100	95-100	85-95	60-80	25-40	10-20
	40-60	Sandy clay loam, loam, sandy loam.	CL, CL-ML, SM-SC, SC	A-6, A-4	0	100	95-100	80-90	35-75	20-40	5-15
Coland-----------	0-48	Clay loam---------	CL, CH	A-7	0	100	100	95-100	65-80	45-55	20-30
	48-60	Clay loam, silty clay loam.	CL, CH	A-7	0	100	100	95-100	65-80	45-55	20-30
5010*, 5030*. Pits											
5040*. Orthents											

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	G/cm^3	In/hr	In/in	pH					Pct
41, 41B, 41C----- Sparta	0-40	3-10	1.20-1.40	2.0-6.0	0.09-0.12	5.1-7.3	Low-----------	0.17	5	2	1-2
	40-60	1-8	1.40-1.60	6.0-20	0.05-0.11	5.1-6.5	Low-----------	0.17			
63B, 63C--------- Chelsea	0-5	8-15	1.50-1.55	6.0-20	0.10-0.15	5.6-7.3	Low-----------	0.17	5	2	.5-1
	5-60	5-10	1.55-1.70	6.0-20	0.06-0.08	5.1-5.5	Low-----------	0.17			
83B, 83C, 83C2--- Kenyon	0-20	20-25	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low-----------	0.28	5	6	2-4
	20-45	20-30	1.45-1.65	0.6-2.0	0.17-0.19	5.1-7.3	Low-----------	0.28			
	45-60	20-24	1.65-1.80	0.6-2.0	0.17-0.19	6.6-7.8	Low-----------	0.37			
84--------------- Clyde	0-22	28-32	1.35-1.40	0.6-2.0	0.21-0.23	6.1-7.3	Moderate-----	0.28	5	7	7-9
	22-32	22-28	1.45-1.65	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.37			
	32-36	10-15	1.60-1.70	2.0-6.0	0.11-0.13	6.1-7.3	Low-----------	0.37			
	36-70	20-24	1.70-1.80	0.6-2.0	0.17-0.19	6.6-8.4	Moderate-----	0.37			
109B------------- Backbone	0-8	8-18	1.50-1.55	2.0-6.0	0.12-0.14	6.6-7.3	Low-----------	0.24	4	3	1-2
	8-32	12-18	1.55-1.65	2.0-6.0	0.11-0.13	5.1-7.3	Low-----------	0.24			
	32-35	36-42	1.65-1.80	0.2-0.6	0.14-0.16	5.6-7.3	High----------	0.24			
	35	---	---	---	---	---	-------------	----			
110, 110B-------- Lamont	0-8	10-15	1.50-1.55	2.0-6.0	0.16-0.18	5.1-7.3	Low-----------	0.24	5	3	.5-1
	8-36	5-15	1.50-1.55	2.0-6.0	0.14-0.16	5.1-7.3	Low-----------	0.24			
	36-60	2-10	1.65-1.75	6.0-20	0.09-0.11	5.1-6.5	Low-----------	0.17			
141-------------- Watseka	0-34	8-13	1.35-1.55	6.0-20	0.10-0.12	5.6-7.3	Low-----------	0.17	5	2	1-3
	34-60	1-10	1.70-2.00	6.0-20	0.05-0.10	5.1-7.3	Low-----------	0.17			
151, 152--------- Marshan	0-21	27-35	1.30-1.40	0.6-2.0	0.20-0.22	5.6-7.3	Moderate-----	0.28	4	7	4-8
	21-26	25-35	1.40-1.55	0.6-2.0	0.17-0.22	5.6-7.3	Moderate-----	0.28			
	26-34	18-30	1.45-1.55	0.6-2.0	0.15-0.19	5.6-7.3	Low-----------	0.28			
	34-60	<5	1.55-1.65	6.0-20	0.02-0.05	6.1-7.3	Low-----------	0.15			
159, 159C-------- Finchford	0-22	5-10	1.50-1.55	>6.0	0.10-0.12	6.1-7.3	Low-----------	0.17	5	2	1-3
	22-35	2-8	1.50-1.60	>20	0.04-0.06	5.1-6.0	Low-----------	0.17			
	35-60	2-5	1.60-1.70	>20	0.02-0.04	5.6-6.5	Low-----------	0.17			
171B, 171C2------ Bassett	0-14	18-25	1.45-1.50	0.6-2.0	0.19-0.21	5.1-6.5	Low-----------	0.28	5-4	6	2-3
	14-36	20-28	1.55-1.65	0.6-2.0	0.17-0.19	4.5-5.5	Low-----------	0.28			
	36-60	20-24	1.65-1.80	0.6-2.0	0.17-0.19	5.1-8.4	Low-----------	0.37			
175, 175B-------- Dickinson	0-8	12-18	1.50-1.55	2.0-6.0	0.12-0.15	5.6-7.3	Low-----------	0.20	4	3	1-2
	8-33	10-15	1.45-1.55	2.0-6.0	0.12-0.15	5.1-6.5	Low-----------	0.20			
	33-45	5-10	1.55-1.65	6.0-20	0.08-0.10	5.1-6.5	Low-----------	0.20			
	45-60	5-10	1.60-1.70	6.0-20	0.02-0.04	5.6-6.5	Low-----------	0.15			
177, 177B-------- Saude	0-16	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low-----------	0.28	4	5	2-3
	16-28	12-20	1.40-1.50	0.6-6.0	0.15-0.19	5.1-6.0	Low-----------	0.28			
	28-60	2-8	1.50-1.75	>20	0.02-0.06	5.1-6.5	Very low-----	0.10			
178-------------- Waukee	0-18	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low-----------	0.24	4	6	3-4
	18-33	20-26	1.40-1.50	0.6-2.0	0.15-0.19	4.5-6.5	Low-----------	0.32			
	33-60	2-8	1.50-1.75	>20	0.02-0.06	5.6-7.3	Low-----------	0.10			
184-------------- Klinger	0-13	26-30	1.30-1.35	0.6-2.0	0.22-0.24	5.1-7.3	Moderate-----	0.32	5	6	5-6
	13-25	28-35	1.35-1.45	0.6-2.0	0.18-0.20	5.1-6.5	Moderate-----	0.43			
	25-60	20-28	1.65-1.80	0.6-2.0	0.17-0.19	5.6-7.8	Low-----------	0.43			
198B------------- Floyd	0-18	20-26	1.35-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Moderate-----	0.24	5	6	5-7
	18-28	18-24	1.40-1.60	0.6-2.0	0.16-0.18	6.1-7.3	Low-----------	0.32			
	28-34	6-12	1.60-1.65	2.0-6.0	0.11-0.13	6.1-7.3	Low-----------	0.32			
	34-60	18-30	1.65-1.80	0.6-2.0	0.16-0.18	6.6-7.8	Low-----------	0.32			

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH					Pct
205B------------- Whalan	0-9	18-25	1.30-1.45	0.6-2.0	0.22-0.24	5.6-7.3	Low----------	0.32	4	6	1-2
	9-27	18-35	1.40-1.55	0.6-2.0	0.17-0.19	5.1-6.5	Low----------	0.32			
	27-36	35-60	1.35-1.45	0.06-0.6	0.15-0.19	5.6-7.8	High---------	0.32			
	36	---	---	---	---	---	-------------	----			
207B------------- Whalan	0-9	18-25	1.30-1.45	0.6-2.0	0.22-0.24	5.6-7.3	Low----------	0.32	4	6	1-2
	9-15	18-35	1.40-1.55	0.6-2.0	0.17-0.19	5.1-6.5	Low----------	0.32			
	15-28	35-60	1.35-1.45	0.06-0.6	0.15-0.19	5.6-7.8	High---------	0.32			
	28	---	---	---	---	---	-------------	----			
213B------------- Rockton	0-18	18-28	1.30-1.40	0.6-2.0	0.20-0.22	5.1-6.5	Low----------	0.28	4	6	3-4
	18-34	25-35	1.40-1.55	0.6-2.0	0.17-0.19	5.1-6.5	Moderate-----	0.28			
	34	---	---	---	---	---	-------------	----			
214-------------- Rockton	0-16	18-28	1.30-1.40	0.6-2.0	0.20-0.22	5.1-6.5	Low----------	0.28	4	6	3-4
	16-24	25-35	1.40-1.55	0.6-2.0	0.17-0.19	5.1-6.5	Moderate-----	0.28			
	24	---	---	---	---	---	-------------	----			
221-------------- Palms	0-45	---	0.25-0.45	0.2-6.0	0.35-0.45	5.1-7.8	-------------	----	---	3	>75
	45-60	7-35	1.45-1.75	0.2-2.0	0.14-0.22	6.1-8.4	Low----------	----			
225-------------- Lawler	0-16	18-28	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.28	4	6	4-5
	16-30	20-28	1.45-1.60	0.6-2.0	0.16-0.18	5.1-6.5	Low----------	0.28			
	30-60	2-12	1.60-1.75	>20	0.02-0.04	5.1-6.5	Low----------	0.10			
226-------------- Lawler	0-16	18-28	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.28	4	6	4-5
	16-34	20-28	1.45-1.60	0.6-2.0	0.16-0.18	5.1-6.5	Low----------	0.28			
	34-60	2-12	1.60-1.75	>20	0.02-0.04	5.1-6.5	Low----------	0.10			
241B*:											
Burkhardt--------	0-13	5-12	1.35-1.55	2.0-6.0	0.13-0.15	5.1-6.5	Low----------	0.20	3	3	2-4
	13-18	8-18	1.55-1.65	2.0-6.0	0.12-0.19	5.1-6.5	Low----------	0.20			
	18-60	1-6	1.50-1.60	6.0-20	0.02-0.04	5.1-6.5	Low----------	0.10			
Saude-----------	0-14	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.28	4	5	3-4
	14-33	12-20	1.40-1.50	0.6-6.0	0.15-0.19	5.1-6.0	Low----------	0.28			
	33-60	2-8	1.50-1.75	>20	0.02-0.06	5.1-6.5	Very low-----	0.10			
284, 284B-------- Flagler	0-19	12-18	1.50-1.55	2.0-6.0	0.12-0.14	5.6-7.3	Low----------	0.20	4	3	1-2
	19-25	10-15	1.55-1.60	2.0-6.0	0.11-0.13	5.1-6.5	Low----------	0.20			
	25-60	2-8	1.60-1.75	>20	0.02-0.04	5.1-7.3	Low----------	0.20			
290-------------- Dells	0-12	14-18	1.35-1.55	0.6-2.0	0.22-0.24	5.6-7.3	Low----------	0.37	4	5	1-3
	12-27	20-32	1.55-1.65	0.6-2.0	0.18-0.22	5.1-6.0	Moderate-----	0.37			
	27-34	10-25	1.55-1.65	0.6-2.0	0.12-0.19	5.1-6.0	Low----------	0.37			
	34-60	2-8	1.55-1.70	6.0-20	0.05-0.10	5.1-6.0	Low----------	0.15			
354*. Aquolls											
377B------------- Dinsdale	0-15	25-29	1.25-1.30	0.6-2.0	0.21-0.23	5.1-7.3	Moderate-----	0.32	5	7	3-5
	15-25	30-34	1.30-1.35	0.6-2.0	0.18-0.20	5.1-6.0	Moderate-----	0.43			
	25-60	20-28	1.65-1.80	0.6-2.0	0.17-0.19	5.6-8.4	Low----------	0.43			
382-------------- Maxfield	0-18	30-35	1.35-1.40	0.6-2.0	0.21-0.23	6.6-7.3	High---------	0.24	5	6	6-7
	18-30	25-34	1.40-1.50	0.6-2.0	0.18-0.20	6.1-7.3	High---------	0.32			
	30-60	20-26	1.65-1.85	0.6-2.0	0.17-0.19	6.1-7.8	Low----------	0.32			
391B*:											
Clyde------------	0-22	28-32	1.35-1.40	0.6-2.0	0.21-0.23	6.1-7.3	Moderate-----	0.28	5	7	7-9
	22-32	22-28	1.45-1.65	0.6-2.0	0.18-0.20	6.1-7.3	Moderate-----	0.37			
	32-36	10-15	1.60-1.70	2.0-6.0	0.11-0.13	6.1-7.3	Low----------	0.37			
	36-70	20-24	1.70-1.80	0.6-2.0	0.17-0.19	6.6-8.4	Moderate-----	0.37			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH					Pct
391B*:											
Floyd	0-18	20-26	1.35-1.40	0.6-2.0	0.20-0.22	6.1-7.3	Moderate	0.24	5	6	5-7
	18-28	18-24	1.40-1.60	0.6-2.0	0.16-0.18	6.1-7.3	Low	0.32			
	28-34	6-12	1.60-1.65	2.0-6.0	0.11-0.13	6.1-7.3	Low	0.32			
	34-60	18-30	1.65-1.80	0.6-2.0	0.16-0.18	6.6-7.8	Low	0.32			
398 Tripoli	0-19	28-32	1.40-1.45	0.6-2.0	0.19-0.21	6.6-7.3	Moderate	0.24	5	6	6-7
	19-35	22-28	1.45-1.70	0.6-2.0	0.17-0.19	7.4-7.8	Low	0.32			
	35-60	20-28	1.70-1.80	0.6-2.0	0.17-0.19	7.4-8.4	Low	0.32			
399 Readlyn	0-22	18-24	1.35-1.40	0.6-2.0	0.20-0.22	5.1-7.3	Low	0.24	5	6	4-6
	22-50	22-28	1.45-1.70	0.6-2.0	0.17-0.19	5.1-6.5	Low	0.32			
	50-60	18-24	1.70-1.80	0.6-2.0	0.17-0.19	6.6-7.8	Low	0.32			
407B Schley	0-13	18-22	1.40-1.45	0.6-2.0	0.19-0.21	4.5-6.5	Moderate	0.32	5	6	2-3
	13-34	15-28	1.45-1.65	0.6-2.0	0.12-0.16	4.5-5.5	Low	0.32			
	34-60	20-28	1.65-1.80	0.6-2.0	0.16-0.18	5.1-7.8	Low	0.32			
408B, 408C Olin	0-29	12-18	1.45-1.50	2.0-6.0	0.13-0.15	5.6-7.3	Low	0.20	5	3	1-2
	29-60	20-28	1.50-1.70	0.6-2.0	0.17-0.19	5.6-6.0	Low	0.32			
412C Sogn	0-18	18-25	1.15-1.20	0.6-2.0	0.17-0.22	6.1-8.4	Moderate	0.32	1	4L	2-3
	18	---	---	---	---	---	---	---			
471 Oran	0-16	16-24	1.40-1.45	0.6-2.0	0.18-0.20	5.1-7.3	Low	0.28	5	6	2-3
	16-39	22-28	1.45-1.70	0.6-2.0	0.17-0.19	5.1-6.5	Low	0.28			
	39-60	20-26	1.45-1.70	0.6-2.0	0.17-0.19	7.4-7.8	Low	0.37			
485 Spillville	0-40	18-26	1.45-1.55	0.6-2.0	0.19-0.21	5.6-7.3	Moderate	0.28	5	6	4-6
	40-60	14-24	1.55-1.70	0.6-6.0	0.15-0.18	5.6-7.3	Low	0.28			
499B, 499D, 499F Nordness	0-12	18-24	1.30-1.35	0.6-2.0	0.20-0.22	5.6-7.3	Low	0.43	2	6	1-2
	12-16	27-35	1.35-1.60	0.06-0.2	0.12-0.15	6.6-7.3	High	0.43			
	16	---	---	---	---	---	---	---			
585*:											
Spillville	0-40	18-26	1.45-1.55	0.6-2.0	0.19-0.21	5.6-7.3	Moderate	0.28	5	6	4-6
	40-60	14-24	1.55-1.70	0.6-6.0	0.15-0.18	5.6-7.3	Low	0.28			
Coland	0-48	27-35	1.40-1.50	0.6-2.0	0.20-0.22	6.1-7.3	High	0.28	5	7	5-7
	48-60	27-35	1.40-1.50	0.6-2.0	0.20-0.22	6.1-7.3	High	0.28			
663B, 663C2, 663F Seaton	0-6	15-22	1.10-1.20	0.6-2.0	0.22-0.24	5.6-7.3	Low	0.37	5-4	6	1-3
	6-60	18-27	1.15-1.30	0.6-2.0	0.20-0.22	5.1-6.5	Low	0.37			
725 Hayfield	0-12	18-28	1.30-1.50	0.6-2.0	0.20-0.24	5.6-6.5	Low	0.32	5	6	2-4
	12-25	18-30	1.40-1.55	0.6-2.0	0.17-0.22	5.1-6.0	Low	0.32			
	25-60	<5	1.55-1.65	6.0-20	0.02-0.04	5.6-7.8	Low	0.15			
761 Franklin	0-14	18-25	1.30-1.35	0.6-2.0	0.21-0.23	4.5-7.3	Moderate	0.32	5	6	2-3
	14-19	30-34	1.35-1.40	0.6-2.0	0.18-0.20	4.5-6.0	Moderate	0.43			
	19-60	20-28	1.65-1.80	0.6-2.0	0.17-0.19	5.1-7.8	Low	0.43			
776, 776C Lilah	0-13	8-15	1.50-1.55	6.0-20	0.11-0.13	5.1-6.0	Low	0.20	2	3	<1
	13-21	8-15	1.55-1.80	6.0-20	0.11-0.13	4.5-5.5	Low	0.20			
	21-60	2-6	1.55-1.85	>20	0.02-0.04	4.5-5.0	Very low	0.20			
777 Wapsie	0-10	12-18	1.40-1.45	0.6-2.0	0.18-0.20	5.6-7.3	Low	0.28	4	6	1-2
	10-27	12-18	1.45-1.50	0.6-2.0	0.15-0.17	5.6-6.0	Low	0.28			
	27-60	2-10	1.50-1.75	>20.0	0.02-0.06	5.1-7.3	Low	0.10			
782B Donnan	0-21	20-26	1.45-1.50	0.6-2.0	0.20-0.22	5.1-7.3	Low	0.28	4	6	2-3
	21-30	28-34	1.45-1.55	0.6-2.0	0.17-0.19	5.1-6.0	Moderate	0.28			
	30-39	42-55	1.65-1.80	<0.06	0.11-0.14	5.6-6.5	High	0.28			
	39-60	28-32	1.70-1.80	0.2-0.6	0.17-0.19	5.6-6.5	Moderate	0.28			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	G/cm3	In/hr	In/in	pH					Pct
798B-------------- Protivin	0-14	20-27	1.45-1.50	0.6-2.0	0.18-0.20	5.1-7.3	Moderate-----	0.28	5	6	5-7
	14-28	20-27	1.50-1.60	0.2-0.6	0.17-0.19	5.1-6.0	Moderate-----	0.37			
	28-60	28-33	1.60-1.85	0.2-0.6	0.15-0.17	6.1-7.8	Moderate-----	0.37			
807B-------------- Schley Variant	0-8	12-20	1.40-1.45	2.0-6.0	0.12-0.15	5.6-7.3	Low----------	0.24	4	3	1-2
	8-37	8-12	1.45-1.55	6.0-20	0.08-0.15	5.1-6.0	Low----------	0.17			
	37-50	2-8	1.55-1.70	6.0-20	0.06-0.08	5.1-6.0	Low----------	0.17			
	50-60	18-24	1.70-1.80	0.6-2.0	0.17-0.19	5.6-6.5	Low----------	0.37			
809B-------------- Bertram	0-18	8-15	1.50-1.55	2.0-6.0	0.12-0.14	6.1-7.3	Low----------	0.20	4	3	1-2
	18-36	12-18	1.55-1.60	2.0-6.0	0.11-0.13	5.6-6.0	Low----------	0.20			
	36-39	30-38	1.60-1.80	0.2-0.6	0.14-0.16	5.6-6.0	Moderate-----	0.20			
	39	---	---	---	---	---	-------------	----			
813--------------- Atkinson	0-20	18-24	1.40-1.45	0.6-2.0	0.20-0.22	5.6-7.3	Low----------	0.28	4	6	3-4
	20-43	24-29	1.45-1.75	0.6-2.0	0.17-0.19	5.6-7.3	Low----------	0.28			
	43	---	---	---	---	---	-------------	----			
883B-------------- Cresco	0-16	20-27	1.45-1.50	0.6-2.0	0.20-0.22	5.1-7.3	Moderate-----	0.28	4	6	3-4
	16-57	20-27	1.50-1.60	0.2-0.6	0.15-0.17	5.1-7.3	Moderate-----	0.28			
	57-60	28-33	1.60-1.85	0.2-0.6	0.17-0.19	5.1-7.8	Moderate-----	0.37			
1585*:											
Spillville-------	0-40	18-26	1.45-1.55	0.6-2.0	0.19-0.21	5.6-7.3	Moderate-----	0.28	5	6	4-6
	40-60	14-24	1.55-1.70	0.6-6.0	0.15-0.18	5.6-7.3	Low----------	0.28			
Coland-----------	0-48	27-35	1.40-1.50	0.6-2.0	0.20-0.22	6.1-7.3	High---------	0.28	5	7	5-7
	48-60	27-35	1.40-1.50	0.6-2.0	0.20-0.22	6.1-7.3	High---------	0.28			
5010*, 5030*. Pits											
5040*. Orthents											

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
41, 41B, 41C: Sparta	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Moderate.
63B, 63C: Chelsea	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Low.
83B, 83C, 83C2: Kenyon	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
84: Clyde	B/D	None	---	---	1.0-2.5	Apparent	Nov-Jul	>60	---	High	High	Low.
109B: Backbone	B	None	---	---	>6.0	---	---	20-40	Hard	Moderate	Low	Low.
110, 110B: Lamont	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Moderate.
141: Watseka	B	None	---	---	1.0-3.0	Apparent	Feb-May	>60	---	Moderate	Low	High.
151, 152: Marshan	B/D	Rare	---	---	1.0-2.5	Apparent	Oct-Jun	>60	---	High	High	Moderate.
159: Finchford	A	Rare	---	---	>6.0	---	---	>60	---	Low	Low	Low.
159C: Finchford	A	None	---	---	>6.0	---	---	>60	---	Low	Low	Low.
171B, 171C2: Bassett	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
175, 175B: Dickinson	B	None	---	---	>6.0	---	---	>60	---	Moderate	Low	Moderate.
177, 177B: Saude	B	None	---	---	>6.0	---	---	>60	---	Low	Low	Moderate.
178: Waukee	B	None	---	---	>6.0	---	---	>60	---	Low	Low	Moderate.
184: Klinger	B	None	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High	High	Moderate.
198B: Floyd	B	None	---	---	2.0-4.0	Apparent	Nov-Jun	>60	---	High	High	Low.
205B, 207B: Whalan	B	None	---	---	>6.0	---	---	20-40	Soft	Moderate	Moderate	Low.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hardness	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In				
213B, 214: Rockton	B	None	---	---	>6.0	---	---	20-40	Soft	Moderate	Low	Low.
221: Palms	A/D	Frequent	Long	Nov-May	+1-1.0	Apparent	Nov-May	>60	---	High	High	Moderate.
225, 226: Lawler	B	None	---	---	2.0-4.0	Apparent	Nov-May	>60	---	High	High	Moderate.
241B*:												
Burkhardt	B	None	---	---	>6.0	---	---	>60	---	Low	Low	High.
Saude	B	None	---	---	>6.0	---	---	>60	---	Low	Low	Moderate.
284, 284B: Flagler	B	None	---	---	>6.0	---	---	>60	---	Low	Moderate	Low.
290: Dells	C	Rare	---	---	1.0-3.0	Apparent	Nov-May	>60	---	High	Low	Moderate.
354*. Aquolls												
377B: Dinsdale	B	None	---	---	>6.0	---	---	>60	---	High	Moderate	Moderate.
382: Maxfield	B/D	None	---	---	1.0-2.0	Apparent	Nov-Jul	>60	---	High	High	Moderate.
391B*:												
Clyde	B/D	None	---	---	1.0-2.5	Apparent	Nov-Jul	>60	---	High	High	Low.
Floyd	B	None	---	---	2.0-4.0	Apparent	Nov-Jun	>60	---	High	High	Low.
398: Tripoli	B/D	None	---	---	1.0-2.0	Apparent	Nov-Jul	>60	---	High	High	Moderate.
399: Readlyn	B	None	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High	High	Moderate.
407B: Schley	B	None	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High	High	High.
408B, 408C: Olin	B	None	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Moderate.
412C: Sogn	D	None	---	---	>6.0	---	---	4-20	Hard	Moderate	Low	Low.
471: Oran	B	None	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High	High	Moderate.
485: Spillville	B	Occasional	Very brief	Feb-Nov	3.0-5.0	Apparent	Nov-Jul	>60	---	Moderate	High	Moderate.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
499B, 499D, 499F-- Nordness	B	None	---	---	>6.0	---	---	8-20	Hard	Low	Low	Low.
585*:												
Spillville	B	Occasional	Very brief	Feb-Nov	3.0-5.0	Apparent	Nov-Jul	>60	---	Moderate	High	Moderate.
Coland	B/D	Occasional	Brief	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High	High	Low.
663B, 663C2, 663F- Seaton	B	None	---	---	>6.0	---	---	>60	---	High	Low	Moderate.
725 Hayfield	B	None	---	---	2.5-5.0	Apparent	Apr-Jun	>60	---	High	Low	Moderate.
761 Franklin	B	None	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High	High	Moderate.
776, 776C Lilah	A	None	---	---	>6.0	---	---	>60	---	Low	Low	High.
777 Wapsie	B	None	---	---	>6.0	---	---	>60	---	Low	Low	Moderate.
782B Donnan	C	None	---	---	2.0-3.0	Perched	Nov-Jul	>60	---	High	High	Moderate.
798B Protivin	C	None	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High	High	Moderate.
807B Schley Variant	B	None	---	---	2.0-4.0	Apparent	Nov-Jul	>60	---	High	Low	Moderate.
809B Bertram	B	None	---	---	>6.0	---	---	20-40	Hard	Moderate	Low	Moderate.
813 Atkinson	B	None	---	---	>6.0	---	---	40-60	Hard	Moderate	Moderate	Moderate.
883B Cresco	C	None	---	---	3.0-5.0	Perched	Nov-Jul	>60	---	High	High	Moderate.
1585*:												
Spillville	B	Frequent	Very brief	Feb-Nov	3.0-5.0	Apparent	Nov-Jul	>60	---	Moderate	High	Moderate.
Coland	B/D	Frequent	Brief	Feb-Nov	1.0-3.0	Apparent	Nov-Jul	>60	---	High	High	Low.
5010*, 5030*. Pits												
5040*. Orthents												

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--CLASSIFICATION OF THE SOILS

[An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series]

Soil name	Family or higher taxonomic class
Aquolls	Mixed, mesic Haplaquolls
Atkinson	Fine-loamy, mixed, mesic Typic Argiudolls
Backbone	Coarse-loamy, mixed, mesic Mollic Hapludalfs
Bassett	Fine-loamy, mixed, mesic Mollic Hapludalfs
Bertram	Coarse-loamy, mixed, mesic Typic Hapludolls
Burkhardt	Sandy, mixed, mesic Typic Hapludolls
Chelsea	Mixed, mesic Alfic Udipsamments
Clyde	Fine-loamy, mixed, mesic Typic Haplaquolls
Coland	Fine-loamy, mixed, mesic Cumulic Haplaquolls
*Cresco	Fine-loamy, mixed, mesic Typic Argiudolls
Dells	Fine-silty over sandy or sandy-skeletal, mixed, mesic Aquollic Hapludalfs
Dickinson	Coarse-loamy, mixed, mesic Typic Hapludolls
Dinsdale	Fine-silty, mixed, mesic Typic Argiudolls
Donnan	Fine-loamy over clayey, mixed, mesic Aquollic Hapludalfs
Finchford	Sandy, mixed, mesic Entic Hapludolls
Flagler	Coarse-loamy, mixed, mesic Typic Hapludolls
Floyd	Fine-loamy, mixed, mesic Aquic Hapludolls
Franklin	Fine-silty, mixed, mesic Udollic Ochraqualfs
Hayfield	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Aquollic Hapludalfs
Kenyon	Fine-loamy, mixed, mesic Typic Hapludolls
Klinger	Fine-silty, mixed, mesic Aquic Hapludolls
Lamont	Coarse-loamy, mixed, mesic Typic Hapludalfs
Lawler	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Aquic Hapludolls
Lilah	Sandy, mixed, mesic Psammentic Hapludalfs
Marshan	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Haplaquolls
Maxfield	Fine-silty, mixed, mesic Typic Haplaquolls
Nordness	Loamy, mixed, mesic Lithic Hapludalfs
Olin	Coarse-loamy, mixed, mesic Typic Hapludolls
Oran	Fine-loamy, mixed, mesic Udollic Ochraqualfs
Orthents	Loamy, mixed, mesic Udorthents
Palms	Loamy, mixed, euic, mesic Terric Medisaprists
Protivin	Fine-loamy, mixed, mesic Aquic Argiudolls
Readlyn	Fine-loamy, mixed, mesic Aquic Hapludolls
Rockton	Fine-loamy, mixed, mesic Typic Argiudolls
Saude	Coarse-loamy over sandy or sandy-skeletal, mixed, mesic Typic Hapludolls
Schley	Fine-loamy, mixed, mesic Udollic Ochraqualfs
Schley Variant	Coarse-loamy, mixed, mesic Udollic Ochraqualfs
Seaton	Fine-silty, mixed, mesic Typic Hapludalfs
*Sogn	Loamy, mixed, mesic Lithic Haplustolls
Sparta	Sandy, mixed, mesic Entic Hapludolls
Spillville	Fine-loamy, mixed, mesic Cumulic Hapludolls
Tripoli	Fine-loamy, mixed, mesic Typic Haplaquolls
Wapsie	Coarse-loamy over sandy or sandy-skeletal, mixed, mesic Mollic Hapludalfs
Watseka	Sandy, mixed, mesic Aquic Hapludolls
Waukee	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Typic Hapludolls
Whalan	Fine-loamy, mixed, mesic Typic Hapludalfs

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COOPERATIVE EXTENSION SERVICE, IOWA STATE UNIVERSITY
DEPARTMENT OF SOIL CONSERVATION, STATE OF IOWA

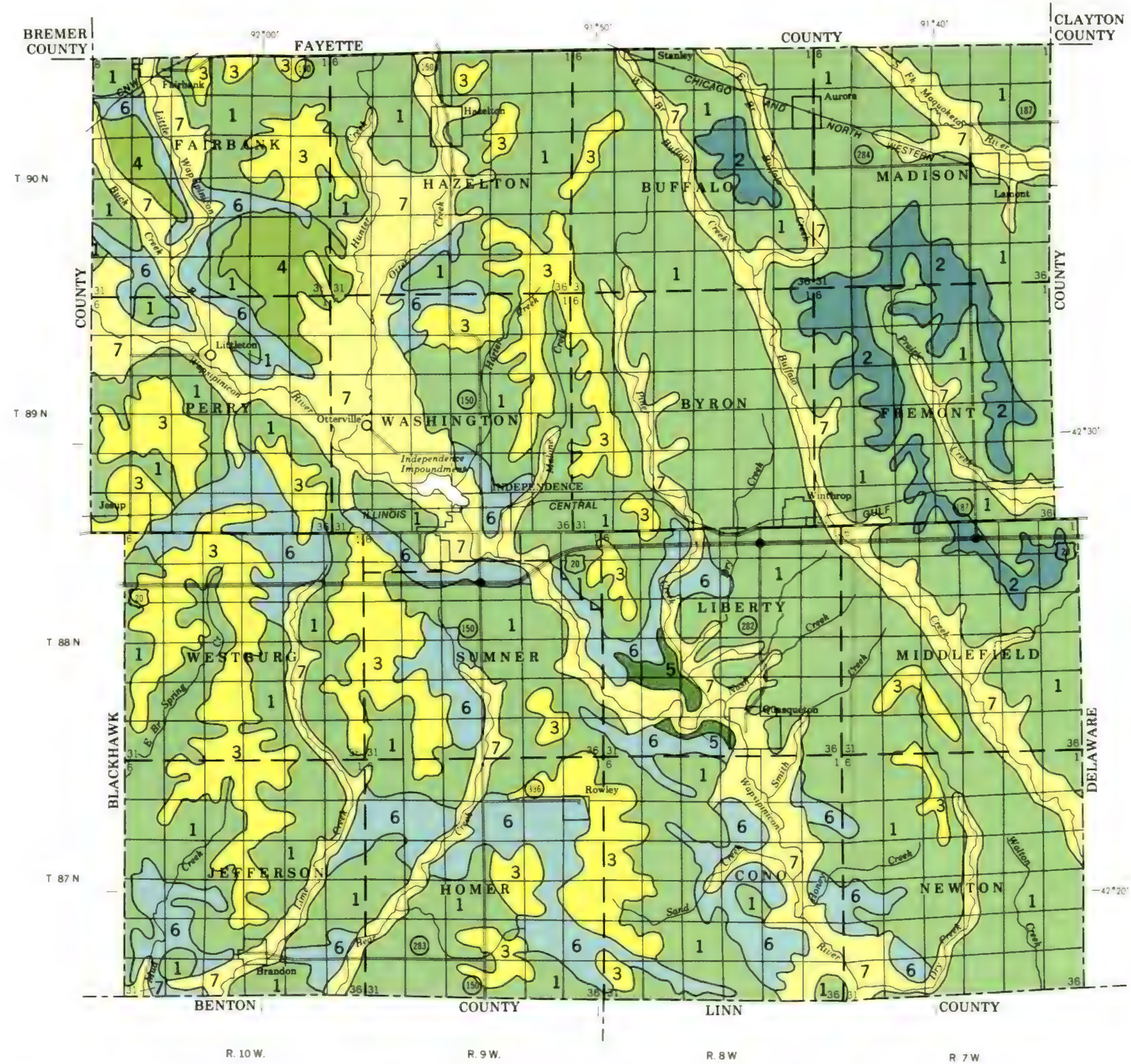
GENERAL SOIL MAP
BUCHANAN COUNTY, IOWA

Scale 1:190,080

1 0 1 2 3 4 Miles

1 0 1 2 3 4 5 6 Kilometers

N



SOIL LEGEND*

1. Kenyon-Clyde-Floyd association: Nearly level to moderately sloping, moderately well drained to poorly drained, loamy soils on uplands
2. Cresco-Clyde-Floyd association: Nearly level to gently sloping, moderately well drained to poorly drained, loamy soils on uplands
3. Readlyn-Tripoli-Oran association: Nearly level and very gently sloping, somewhat poorly drained and poorly drained, loamy soils on uplands
4. Klinger-Maxfield-Franklin association: Nearly level and very gently sloping, somewhat poorly drained and poorly drained, silty soils on uplands
5. Seaton association: Gently sloping to very steep, well drained, silty soils on uplands
6. Olin-Sparta-Chelsea association: Nearly level to moderately sloping, well drained and excessively drained, loamy and sandy soils on uplands and stream benches
7. Spillville-Coland-Marshan association: Nearly level, moderately well drained to poorly drained, loamy soils on flood plains and low stream benches

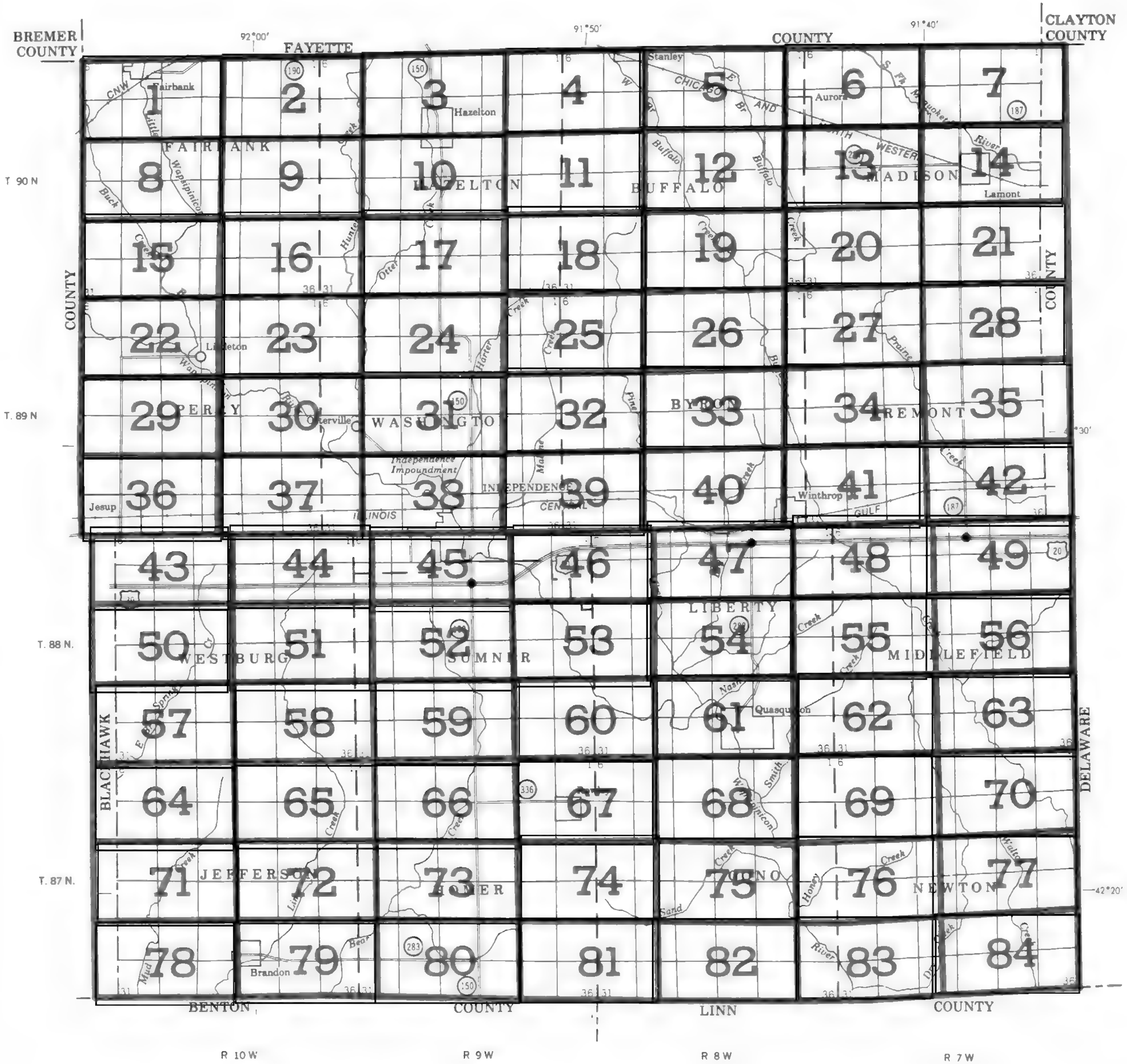
*The texture terms in the descriptive headings refer to the surface layer of the major soils in each association.

Compiled 1980

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36



INDEX TO MAP SHEETS
BUCHANAN COUNTY, IOWA

Scale 1:190,080

1 0 1 2 3 4 Miles

1 0 1 2 3 4 5 6 Kilometers

Original text from each individual map sheet read:
This map is compiled on 1972 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and Cooperating Agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

SOIL LEGEND

Map symbols consist of numbers or a combination of numbers and letters. The initial numbers represent the kind of soil. A capital letter following these numbers indicates the class of slope. Symbols without a slope letter are for nearly level soils or miscellaneous areas. A final number of 2 following the slope letter indicates that the soil is moderately eroded.

SYMBOL	NAME
41	Sparta loamy fine sand, 0 to 2 percent slopes
41B	Sparta loamy fine sand, 2 to 5 percent slopes
41C	Sparta loamy fine sand, 5 to 9 percent slopes
63B	Chelsea loamy fine sand, 2 to 5 percent slopes
63C	Chelsea loamy fine sand, 5 to 9 percent slopes
83B	Kenyon loam, 2 to 5 percent slopes
83C	Kenyon loam, 5 to 9 percent slopes
83C2	Kenyon loam, 5 to 9 percent slopes, moderately eroded
84	Clyde clay loam, 0 to 3 percent slopes
109B	Backbone fine sandy loam, 2 to 6 percent slopes
110	Lamont fine sandy loam, 0 to 2 percent slopes
110B	Lamont fine sandy loam, 2 to 5 percent slopes
141	Watseka loamy fine sand, 1 to 3 percent slopes
151	Marshan clay loam, 24 to 32 inches to sand and gravel, 0 to 2 percent slopes
152	Marshan clay loam, 32 to 40 inches to sand and gravel, 0 to 2 percent slopes
159	Finchford loamy sand, 0 to 2 percent slopes
159C	Finchford loamy sand, 2 to 9 percent slopes
171B	Bassett loam, 2 to 5 percent slopes
171C2	Bassett loam, 5 to 9 percent slopes, moderately eroded
175	Dickinson fine sandy loam, 0 to 2 percent slopes
175B	Dickinson fine sandy loam, 2 to 5 percent slopes
177	Saude loam, 0 to 2 percent slopes
177B	Saude loam, 2 to 5 percent slopes
178	Waukee loam, 0 to 2 percent slopes
184	Klinger silty clay loam, 1 to 3 percent slopes
198B	Floyd loam, 1 to 4 percent slopes
205B	Whalan silt loam, 30 to 40 inches to limestone, 2 to 5 percent slopes
207B	Whalan silt loam, 20 to 30 inches to limestone, 2 to 5 percent slopes
213B	Rockton loam, 30 to 40 inches to limestone, 2 to 6 percent slopes
214	Rockton loam, 20 to 30 inches to limestone, 0 to 2 percent slopes
221	Palms muck, 1 to 4 percent slopes
225	Lawler loam, 24 to 32 inches to sand and gravel, 0 to 2 percent slopes
226	Lawler loam, 32 to 40 inches to sand and gravel, 0 to 2 percent slopes
241B	Burkhardt-Saude complex, 2 to 5 percent slopes
284	Flagler sandy loam, 0 to 2 percent slopes
284B	Flagler sandy loam, 2 to 5 percent slopes
290	Dells silt loam, 0 to 2 percent slopes
354	Aquolls, ponded
377B	Dinsdale silt loam, 2 to 5 percent slopes
382	Maxfield silty clay loam, 0 to 2 percent slopes
391B	Clyde-Floyd complex, 1 to 4 percent slopes
398	Tripoli clay loam, 0 to 2 percent slopes
399	Readlyn loam, 1 to 3 percent slopes
407B	Schley loam, 1 to 4 percent slopes
408B	Olin fine sandy loam, 2 to 5 percent slopes
408C	Olin fine sandy loam, 5 to 9 percent slopes
412C	Sogn loam, 2 to 9 percent slopes
471	Oran loam, 1 to 3 percent slopes
485	Spillville loam, 0 to 2 percent slopes
499B	Nordness loam, 2 to 5 percent slopes
499D	Nordness loam, 5 to 14 percent slopes
499F	Nordness loam, 14 to 30 percent slopes
585	Spillville-Coland complex, 0 to 2 percent slopes
663B	Seaton silt loam, 2 to 5 percent slopes
663C2	Seaton silt loam, 5 to 14 percent slopes, moderately eroded
663F	Seaton silt loam, 14 to 30 percent slopes
725	Hayfield loam, 24 to 32 inches to sand and gravel, 0 to 2 percent slopes
761	Franklin silt loam, 1 to 3 percent slopes
776	Lilah sandy loam, 0 to 2 percent slopes
776C	Lilah sandy loam, 2 to 9 percent slopes
777	Wapsie loam, 0 to 2 percent slopes
782B	Donnan loam, 2 to 6 percent slopes
798B	Protivin loam, 1 to 4 percent slopes
807B	Schley Variant sandy loam, 1 to 4 percent slopes
809B	Bertram fine sandy loam, 2 to 6 percent slopes
813	Atkinson loam, 0 to 2 percent slopes
883B	Cresco loam, 2 to 5 percent slopes
1585	Spillville-Coland complex, channeled, 0 to 2 percent slopes
5010	Pits, sand and gravel
5030	Pits, limestone quarries
5040	Orthents, loamy

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool (Davis Airstrip; FLOOD POOL LINE)

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEMS & DESIGNATIONS

- Interstate
- Federal
- State
- County, farm or ranch

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label) — Indian Mound
- Located object (label) — Tower
- Tank (label) — GAS
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
  - Crossable with tillage implements
  - Not crossable with tillage implements
- Drainage end
- Canals or ditches
  - Double-line (label) — CANAL
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial — water, w
- Intermittent — int, i

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS — 63B 1585

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

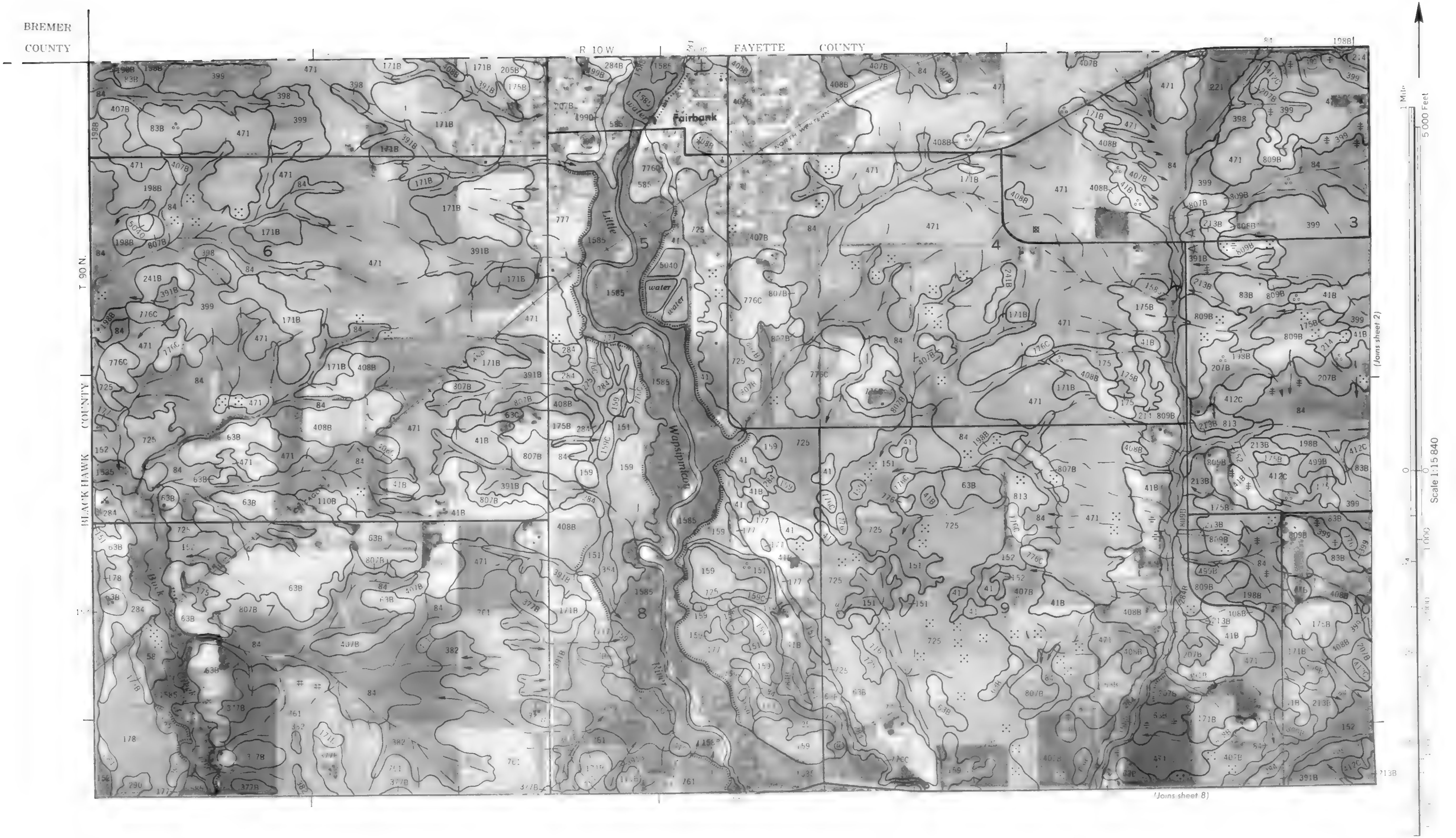
GULLY

DEPRESSION OR SINK

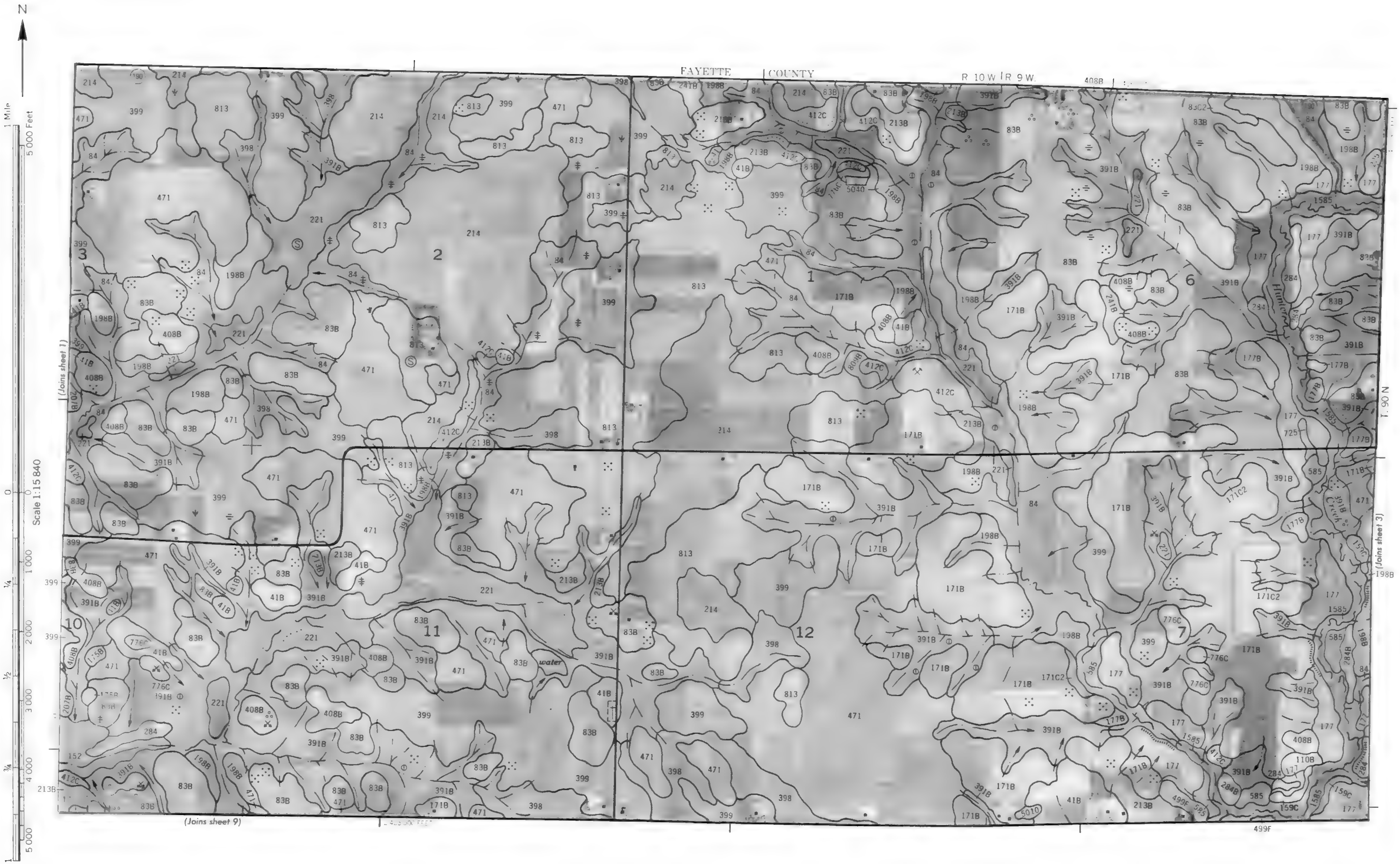
SOIL SAMPLE SITE (normally not shown)

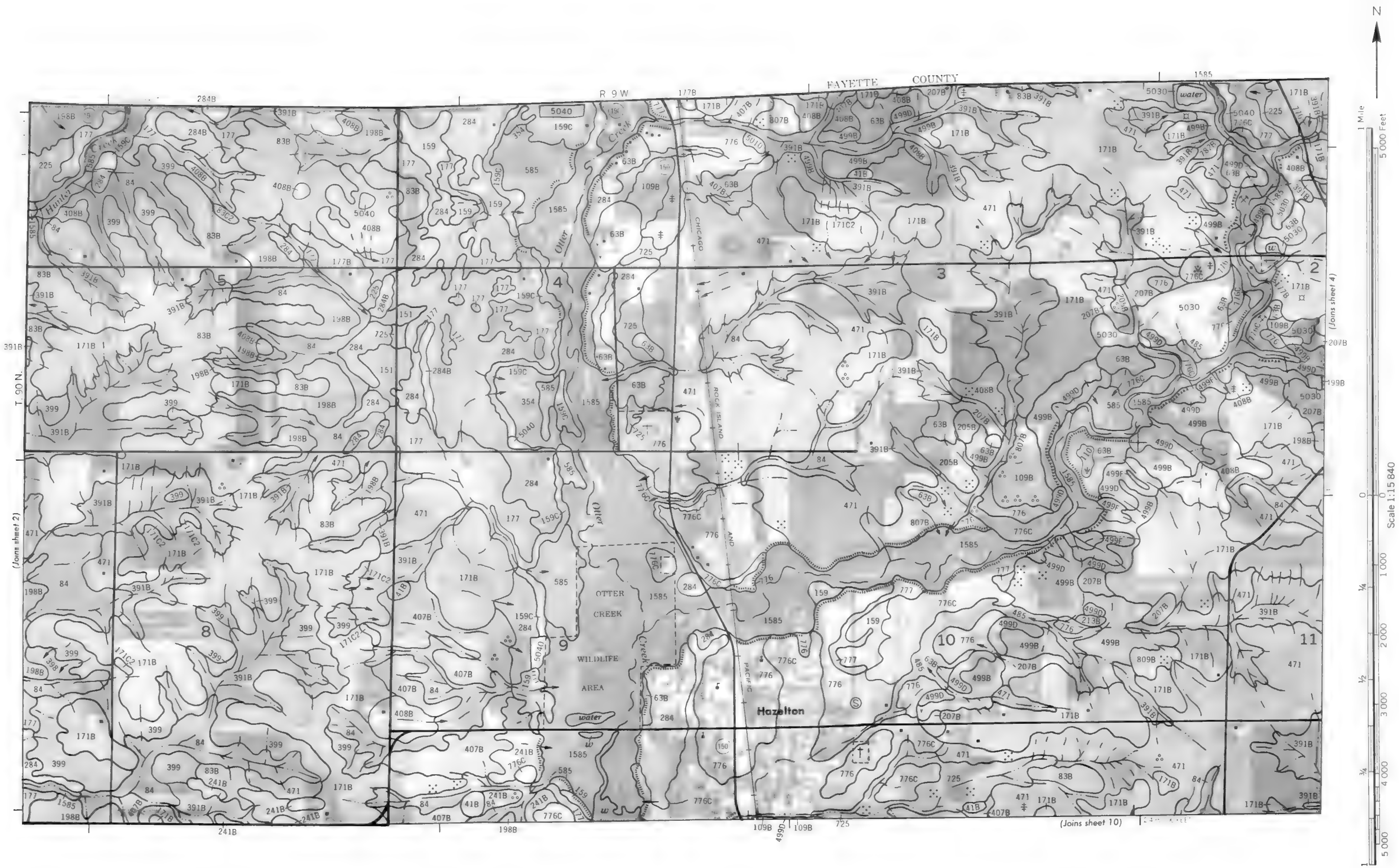
MISCELLANEOUS

- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot
- Spot with gray clay at a depth of 2 to 4 feet
- Muck spot
- Spot with limestone at a depth of 2 to 3 feet
- Spot with shale at a depth of 1 to 2 feet
- Made land or borrow area
- Glacial till spot
- Sewage lagoon — S.L.

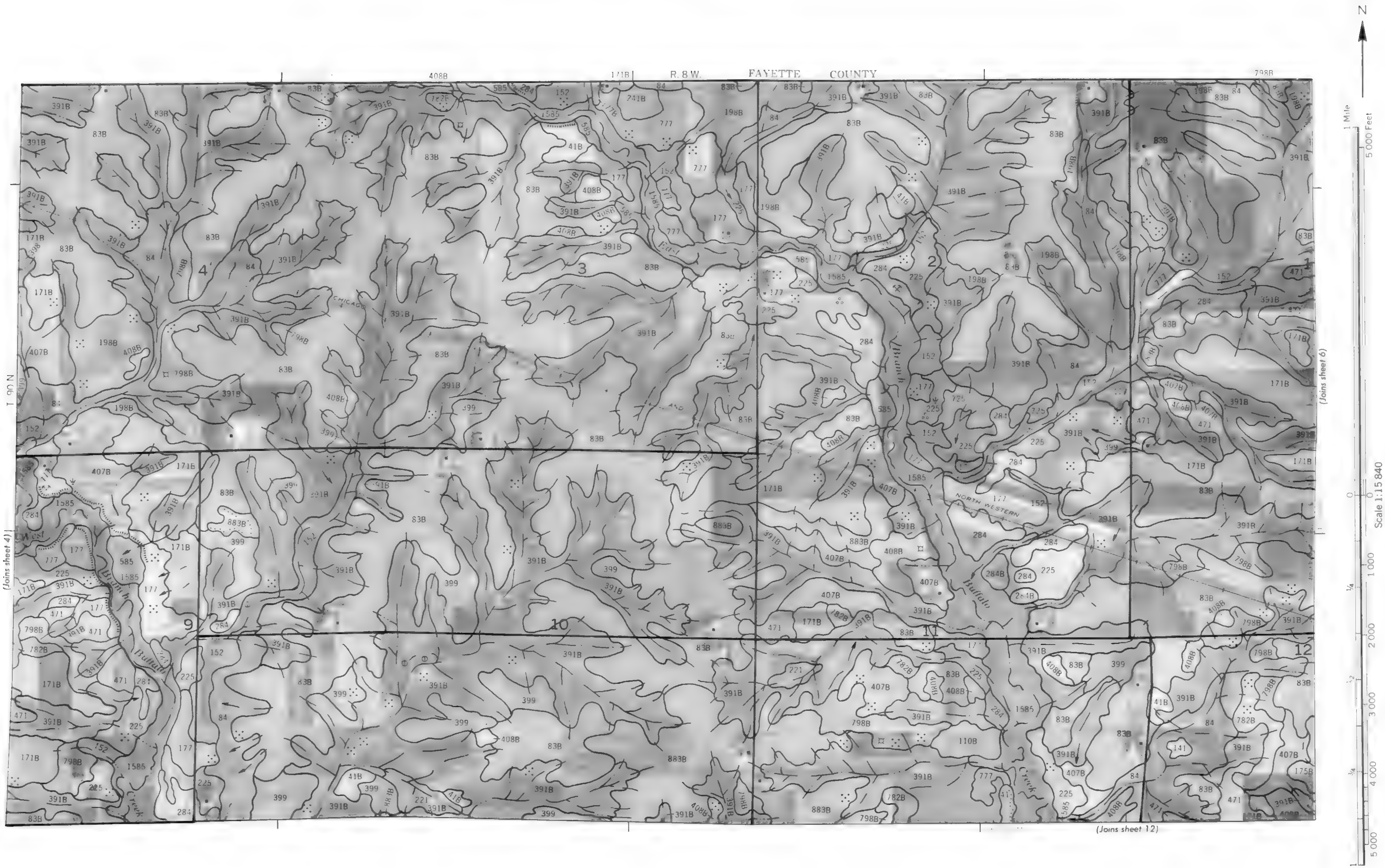

1
N
BREMER COUNTY
FAYETTE COUNTY
BLACK HAWK COUNTY
R. 10 W.
T. 90 N.
Fairbank
Little Wapsipinicon River
(Joins sheet 2)
(Joins sheet 8)
Scale 1:15 840
1 Mile
5 000 Feet

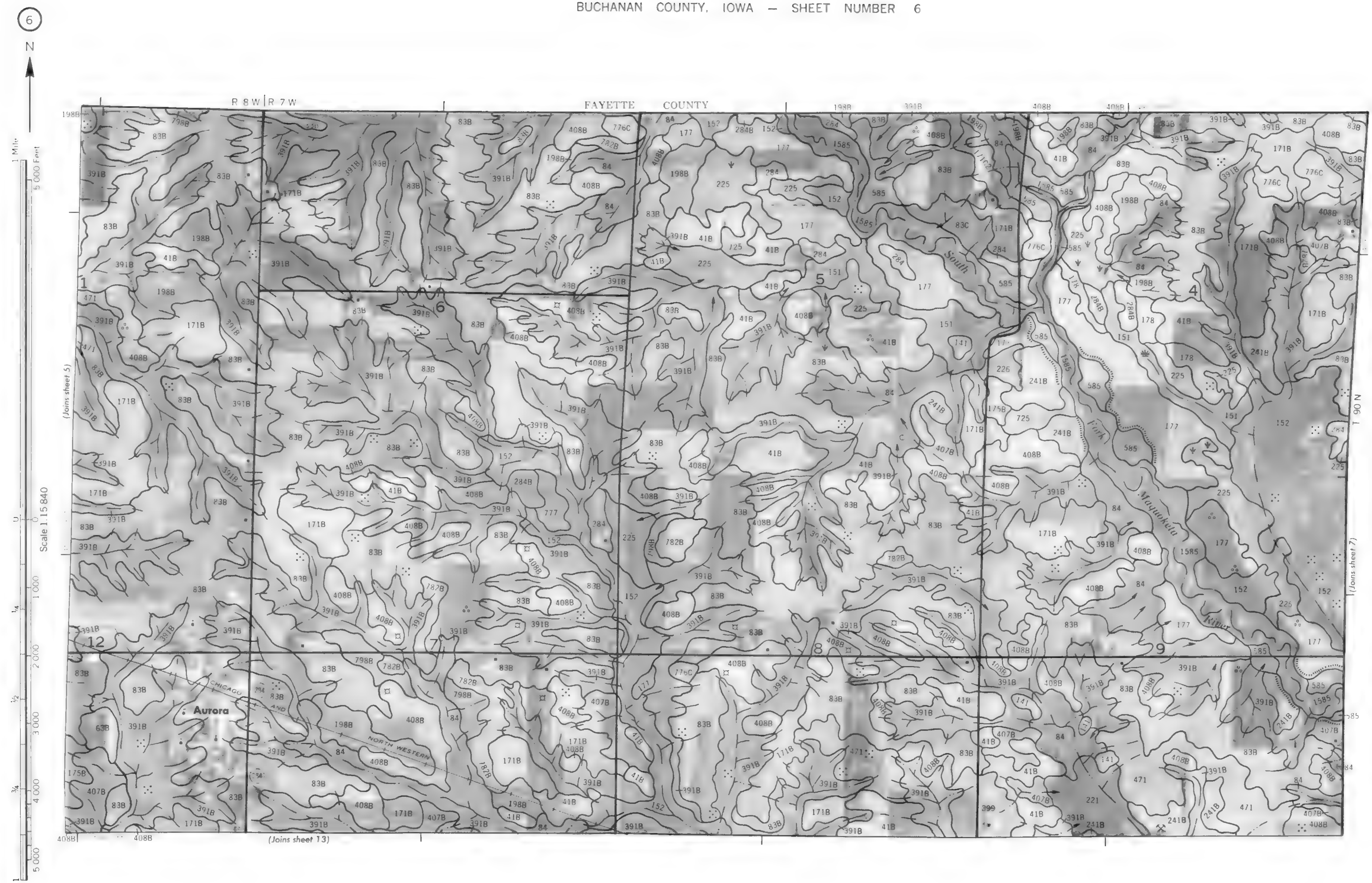
BUCHANAN COUNTY, IOWA — SHEET NUMBER 2

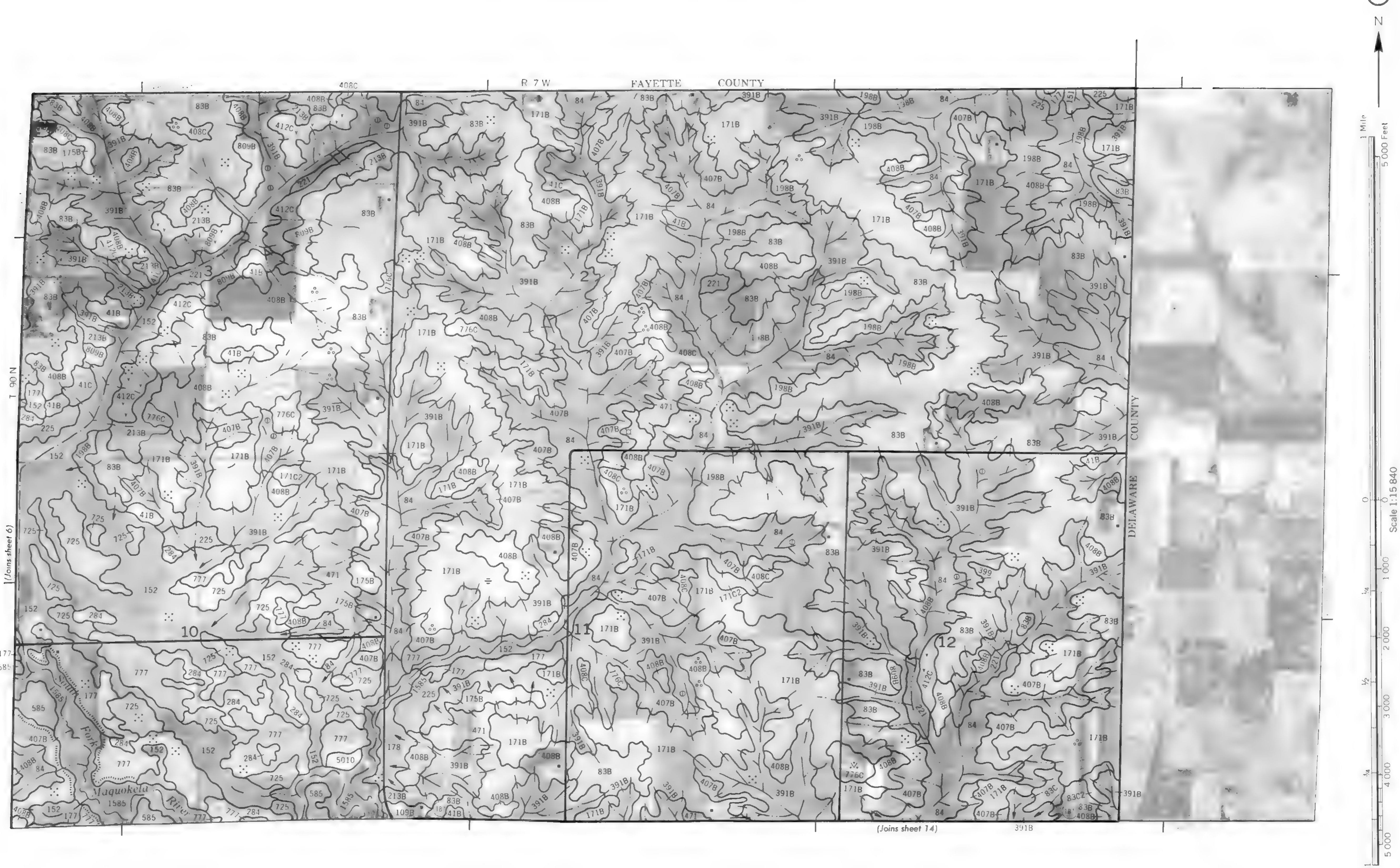


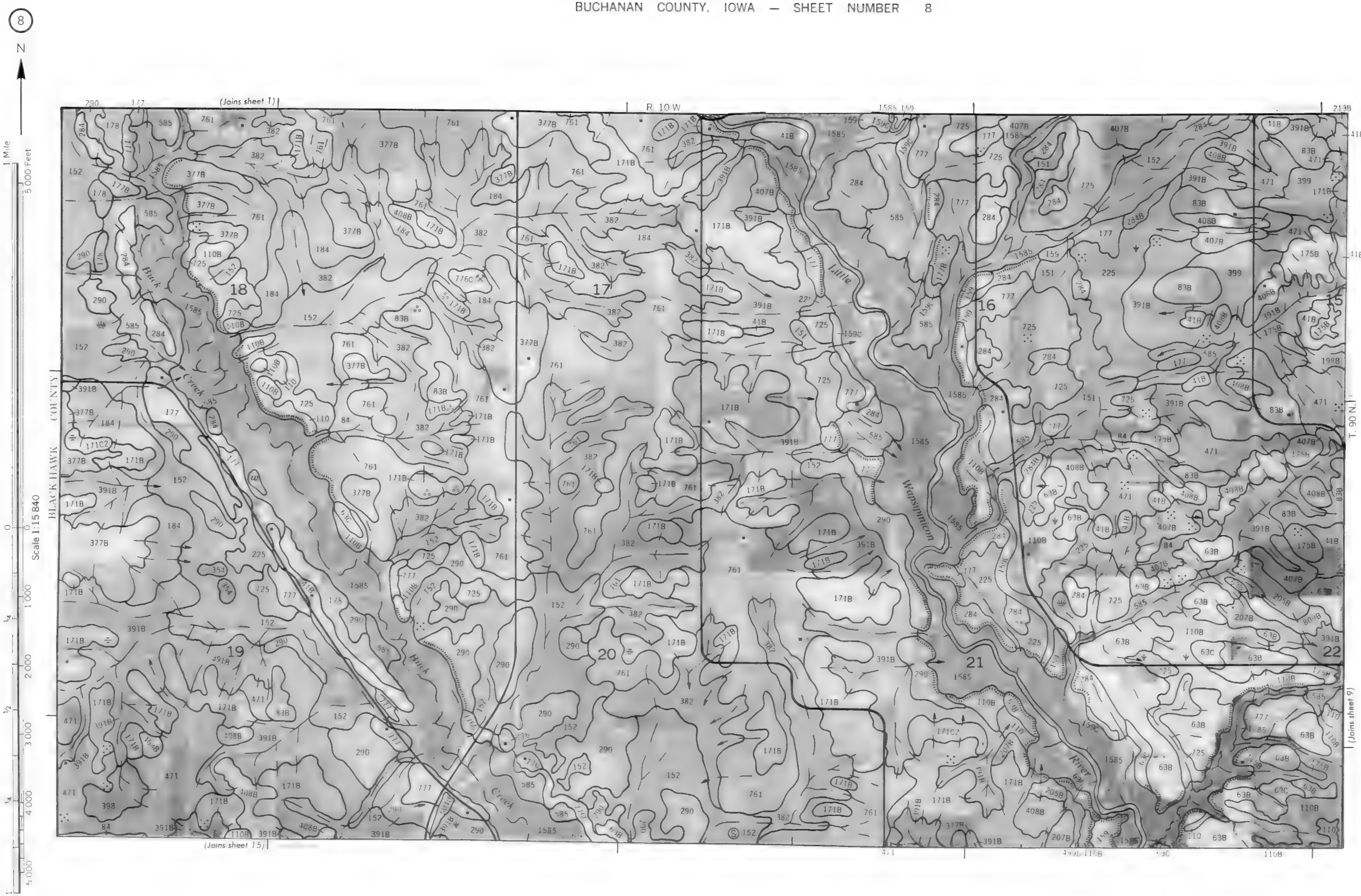

N
FAYETTE COUNTY
R 9 W
T. 90 N.
(Joins sheet 2)
(Joins sheet 4)
(Joins sheet 10)
Hunter Creek
Otter Creek
OTTER CREEK WILDLIFE AREA
water
CHICAGO ROCK ISLAND AND PACIFIC
Hazelton
Scale 1:15 840
1 Mile
5 000 Feet
0
1/4
1/2
3/4
1 000
2 000
3 000
4 000
5 000


4
N
R 9 W | R 8 W
FAYETTE COUNTY
Stanley
CHICAGO AND NORTH WESTERN
Branch
Buffalo Creek
T. 90 N.
(Joins sheet 3)
(Joins sheet 5)
(Joins sheet 11)
Scale 1:15 840
1 Mile
5 000 Feet
1
2
5
6
8
11
12

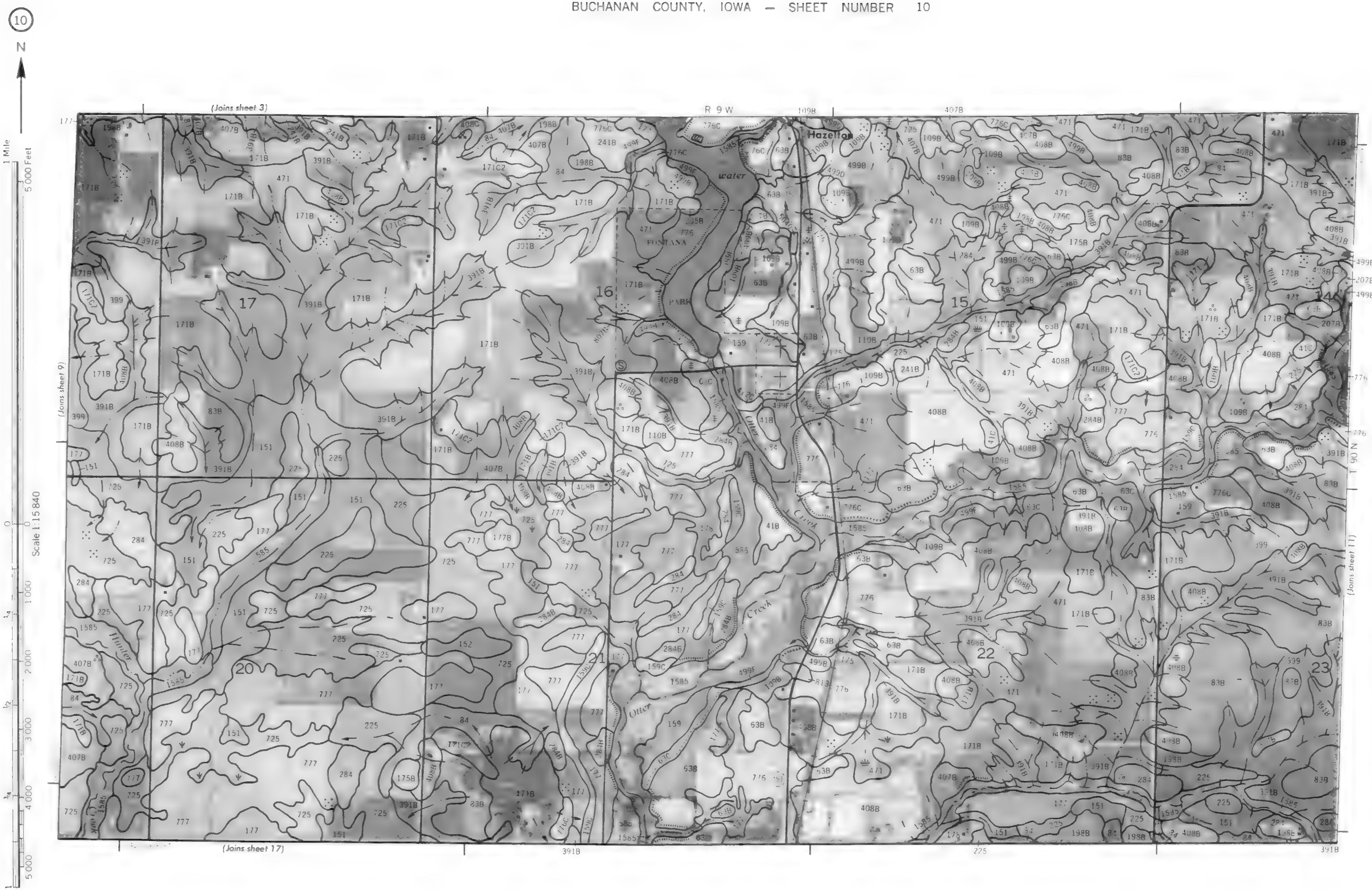

FAYETTE COUNTY
R. 8 W.
T. 90 N.
(Joins sheet 6)
(Joins sheet 4)
(Joins sheet 12)
CHICAGO
NORTH WESTERN
Buffalo
Creek
Branch
West
East
N
1 Mile
5 000 Feet
Scale 1:15 840
0
1 000
2 000
3 000
4 000
5 000

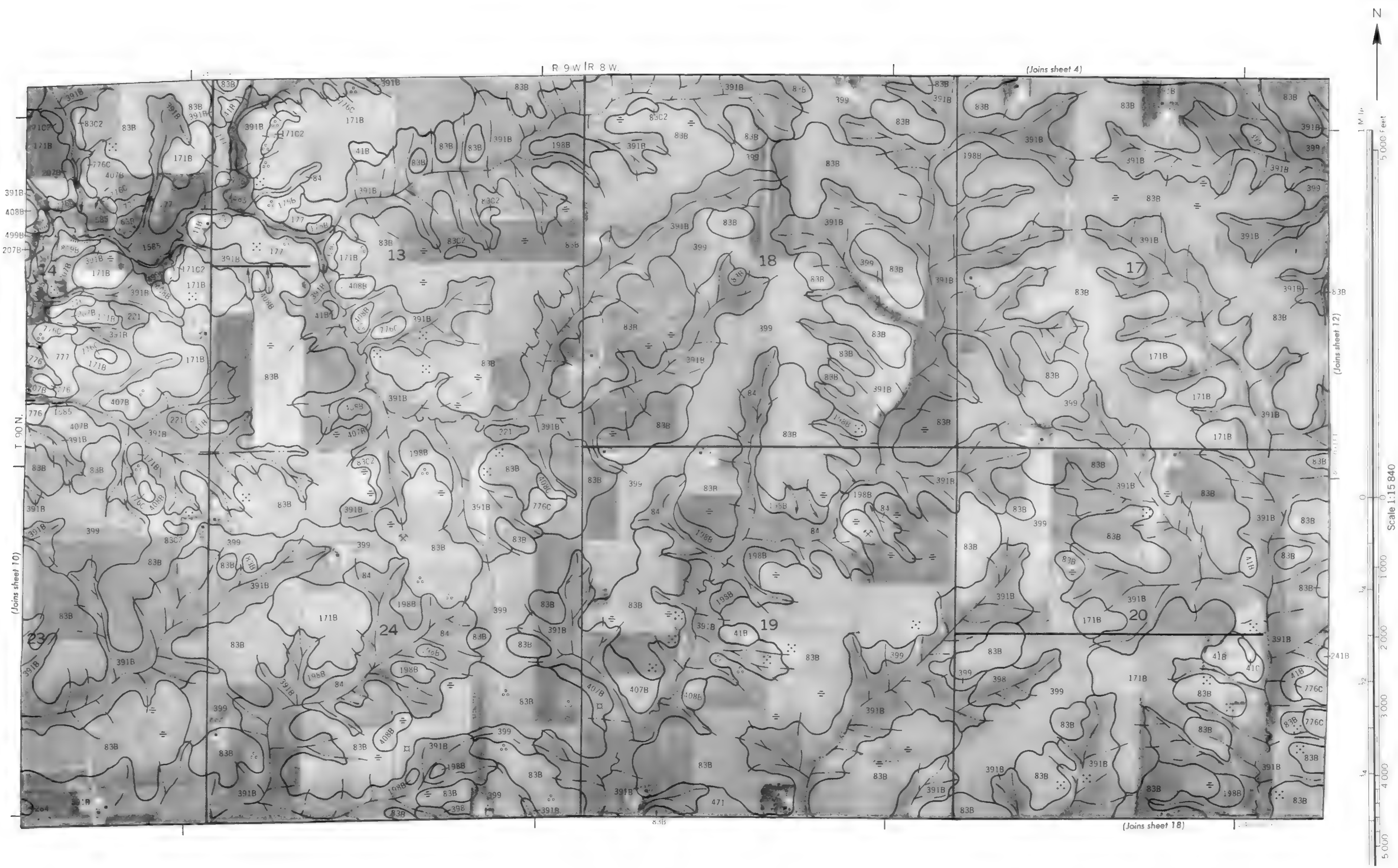

6
N
R 8 W | R 7 W
FAYETTE COUNTY
(Joins sheet 5)
(Joins sheet 7)
(Joins sheet 13)
T 90 N
Scale 1:15 840
1 Mile
5 000 Feet
Aurora
CHICAGO AND NORTH WESTERN
South Fork Maquoketa River


N
FAYETTE COUNTY
R 7 W
T 90 N
DELAWARE COUNTY
(Joins sheet 6)
(Joins sheet 14)
South Fork
Maquoketa River
1 Mile
5 000 Feet
Scale 1:15 840

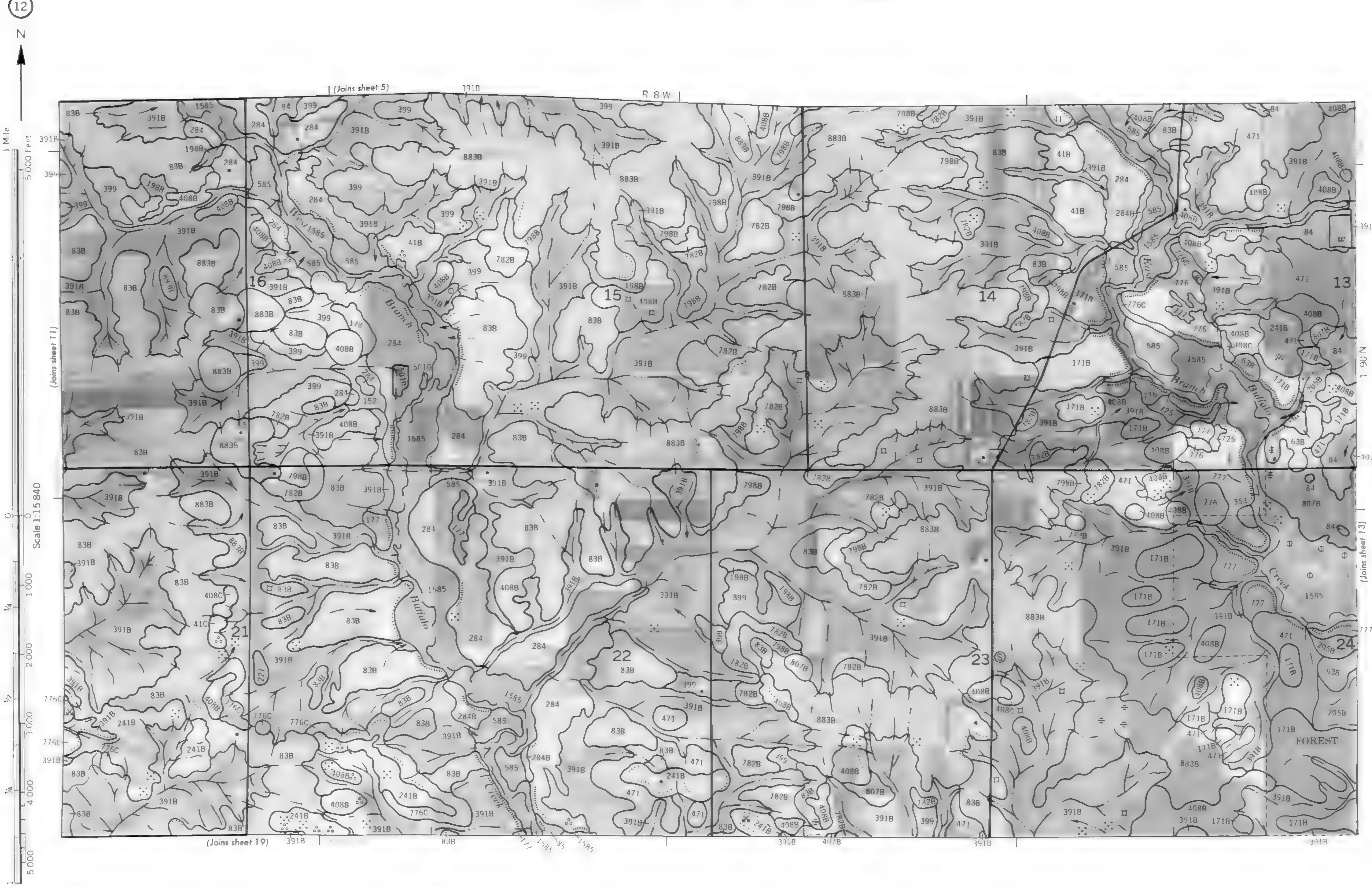

8
N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 1)
R. 10 W.
T. 90 N.
(Joins sheet 9)
(Joins sheet 15)
BLACK HAWK COUNTY
Buck Creek
Little Wapsipinicon River
Buck Creek
18
17
16
15
19
20
21
22


N
R 10 W | R 9 W
T 90 N
(Joins sheet 2)
(Joins sheet 8)
(Joins sheet 10)
(Joins sheet 16)
15
14
13
18
22
23
24
19
Hunter Creek
1 Mile
5 000 Feet
0
1 000
2 000
3 000
4 000
5 000
Scale 1:15 840


10
N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 3)
(Joins sheet 9)
(Joins sheet 11)
(Joins sheet 17)
R 9 W
T 90 N
Hazelton
FONTANA
PARK
water
Otter Creek
Hunter
17
16
15
14
20
21
22
23

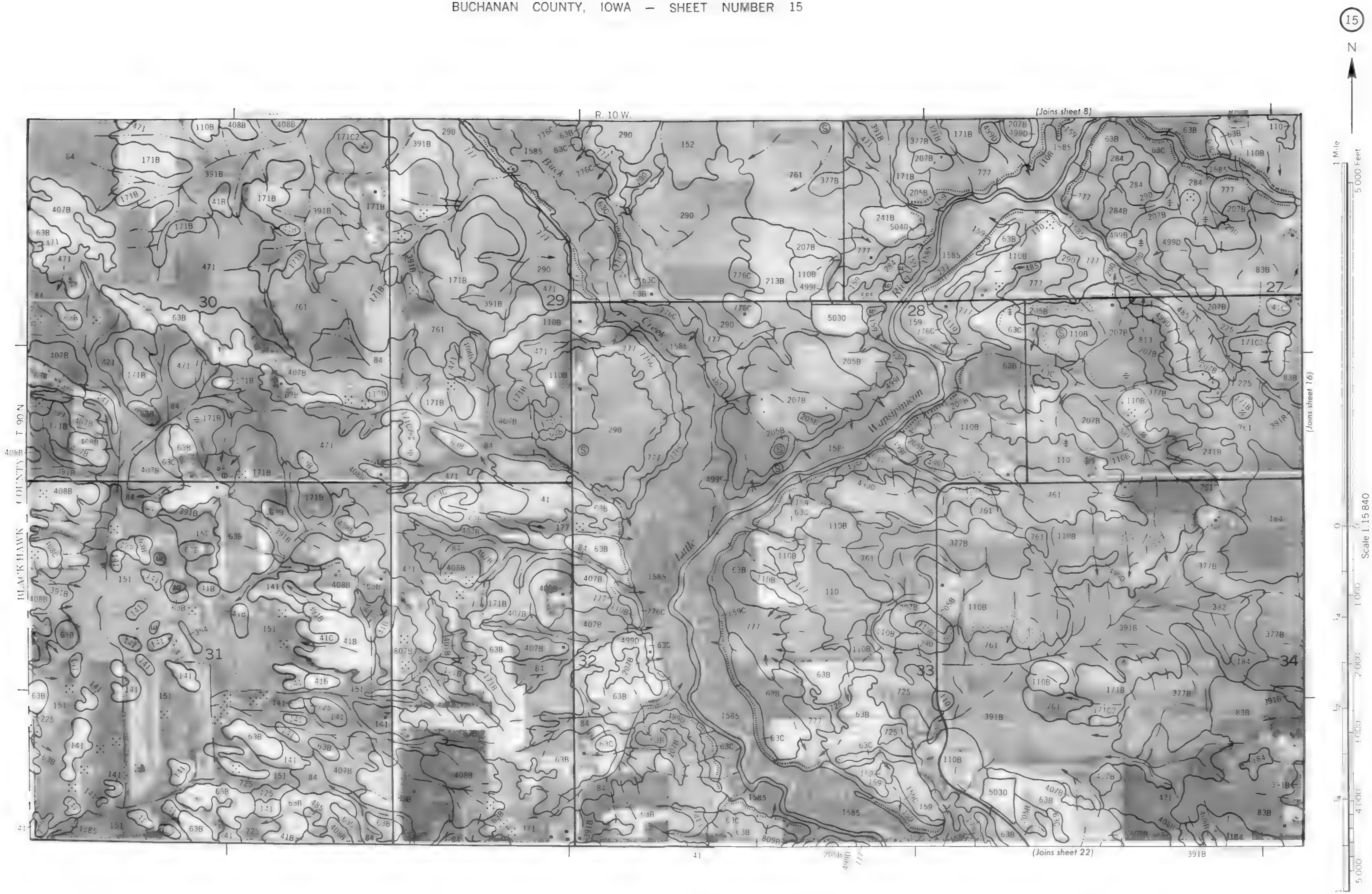


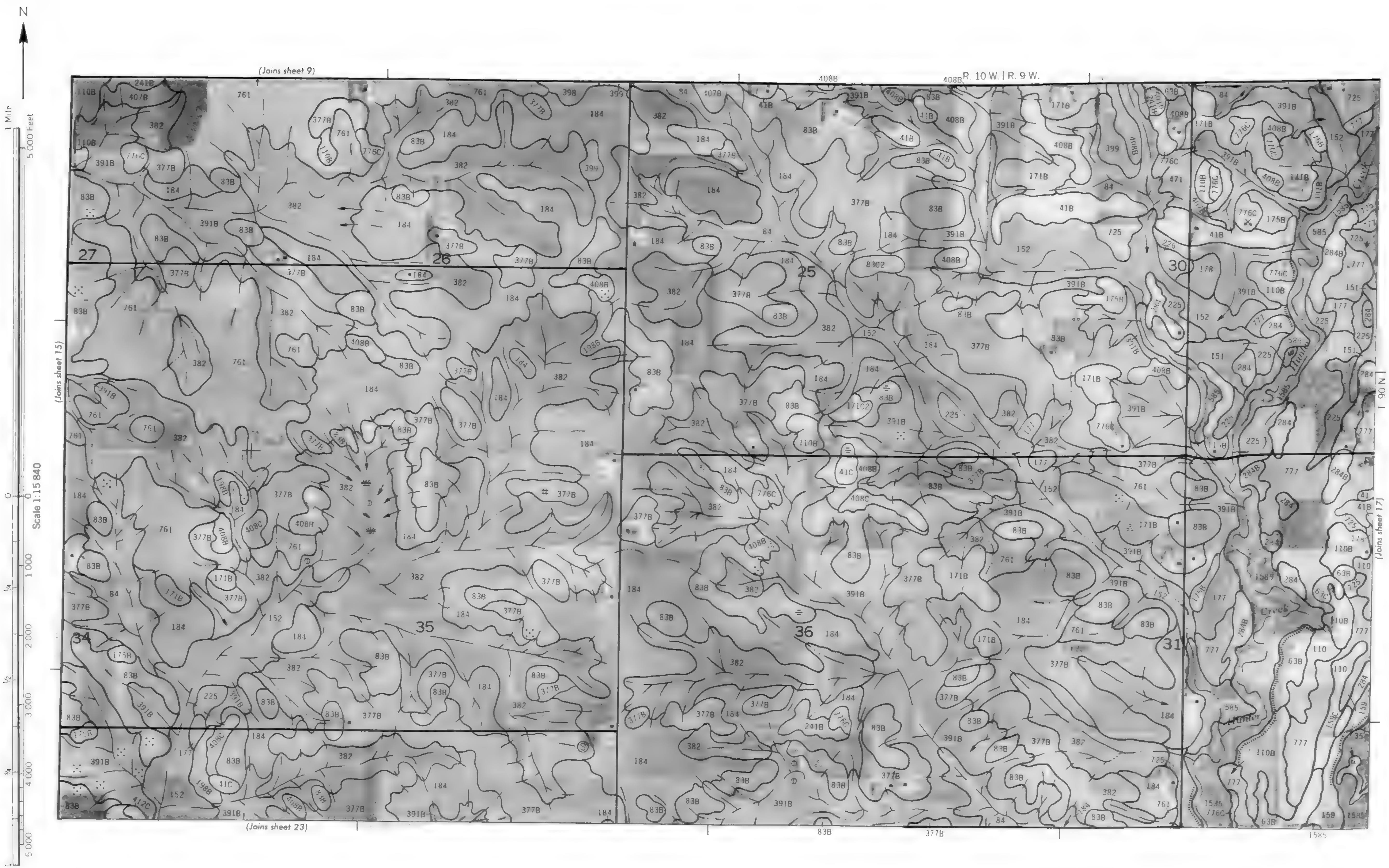
11
N
R 9 W | R 8 W
(Joins sheet 4)
(Joins sheet 12)
(Joins sheet 18)
(Joins sheet 10)
T 90 N.
13
18
17
24
19
20
Scale 1:15 840
1 Mile
5 000 Feet
0
1 000
2 000
3 000
4 000
5 000

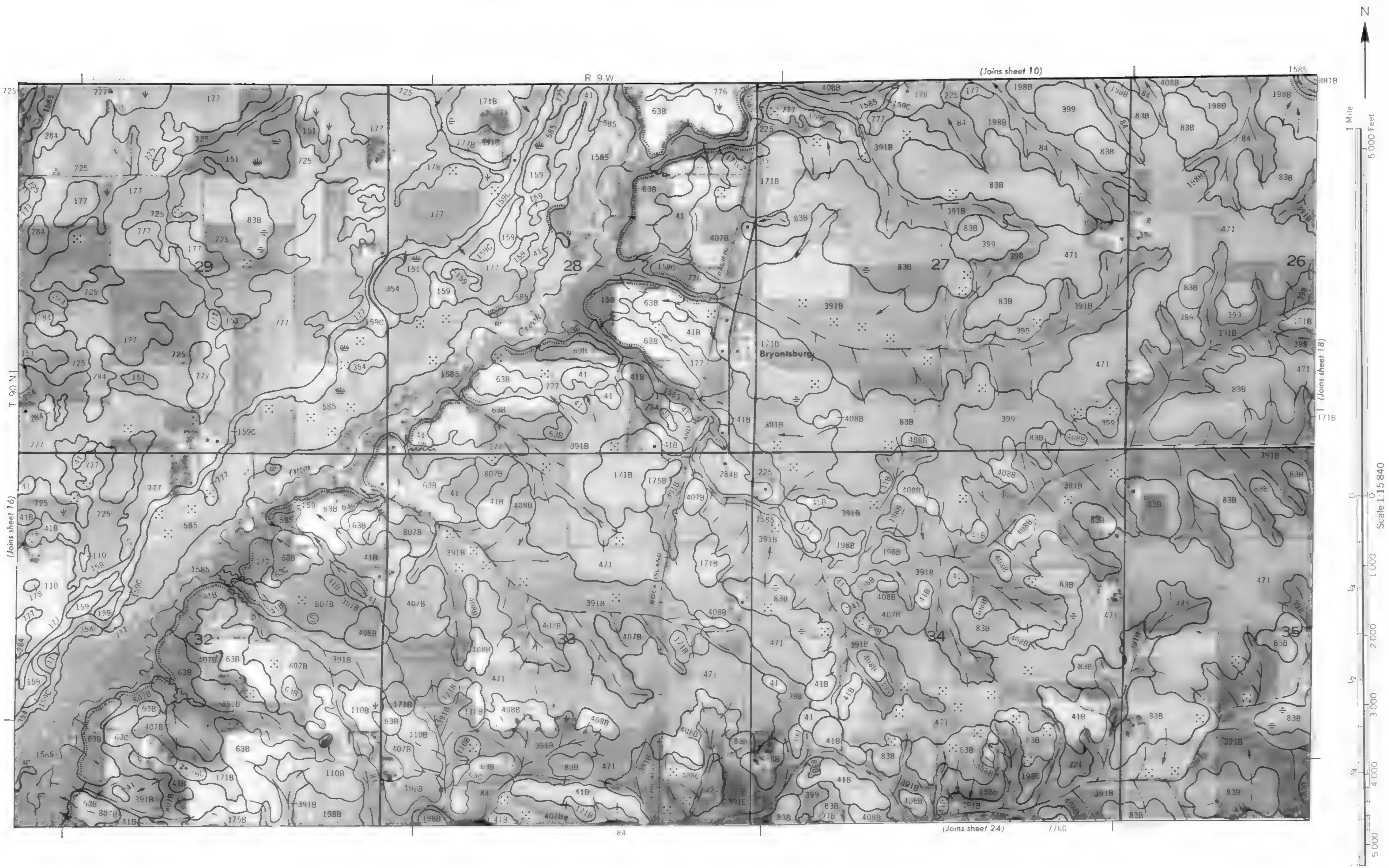

12
N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 5)
R 8 W
(Joins sheet 11)
(Joins sheet 13)
(Joins sheet 19)
T 90 N
16
15
14
13
21
22
23
24
West Branch
Buffalo
Buffalo Creek
FOREST


13
N
R. 8 W. | R. 7 W.
(Joins sheet 6)
(Joins sheet 12)
(Joins sheet 14)
(Joins sheet 20)
T. 90 N.
13
18
17
16
24
19
20
21
CHICAGO
AND
NORTH WESTERN
JAKWAY
FOREST
East
Branch
Buffalo
Creek
1 Mile
5 000 Feet
Scale 1:15 840
0
1 000
2 000
3 000
4 000
5 000
2 490 000 FEET


N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 7)
R. 7 W
(Joins sheet 13)
(Joins sheet 21)
T. 90 N
DELAWARE COUNTY
Lamont
South Fork
Maquoketa River
CHICAGO AND NORTH WESTERN
water
15
14
13
22
23
24


15
N
R. 10 W.
(Joins sheet 8)
(Joins sheet 16)
(Joins sheet 22)
T. 90 N.
BLACK HAWK COUNTY
Buck Creek
Little
Wapsipinicon River
30
29
28
27
31
32
33
34
1 Mile
5 000 Feet
Scale 1:15 840

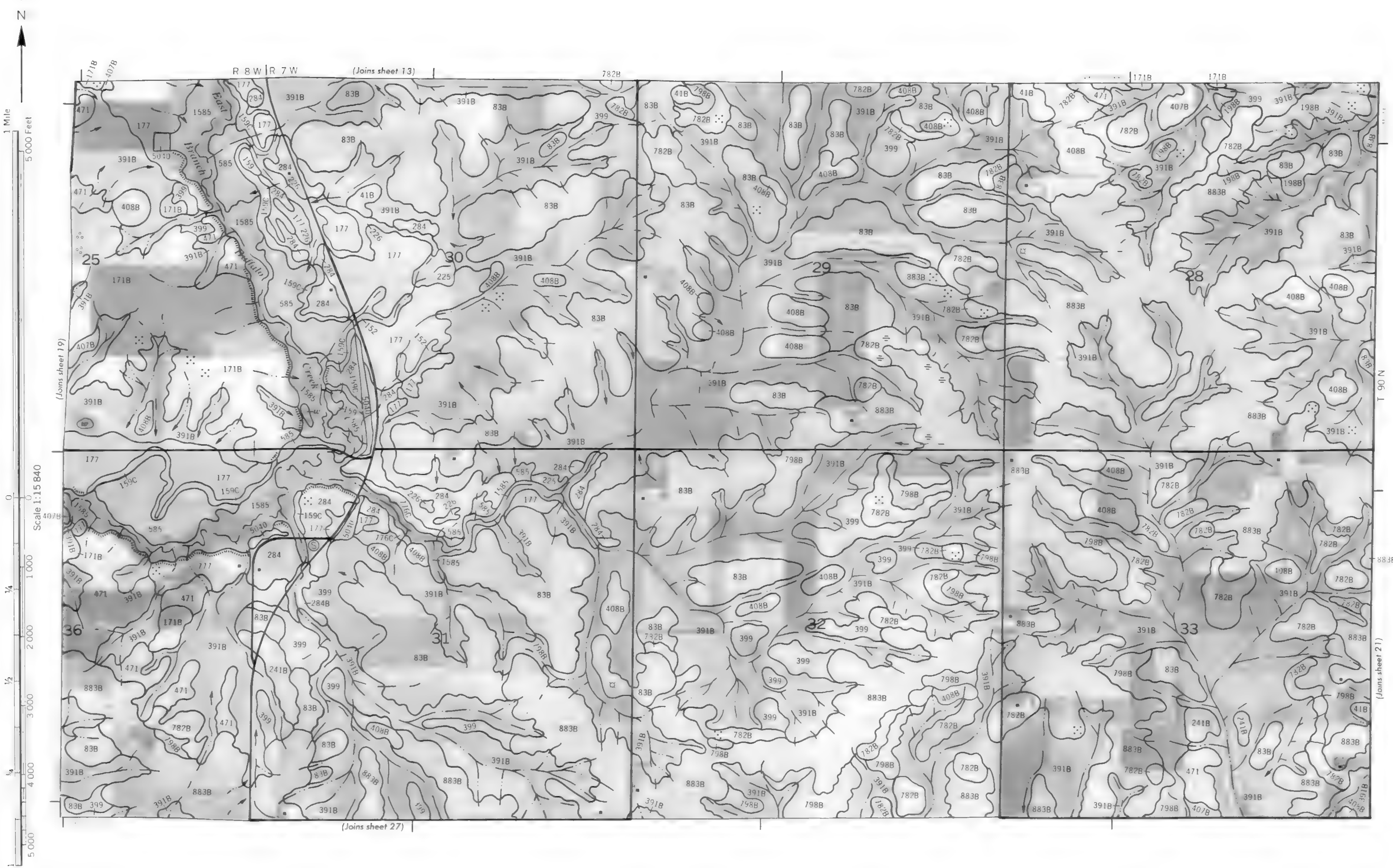

N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 9)
R. 10 W. | R. 9 W.
(Joins sheet 15)
(Joins sheet 17)
(Joins sheet 23)
T. 90 N.
27
26
25
30
35
36
31
34
Hunter
Creek

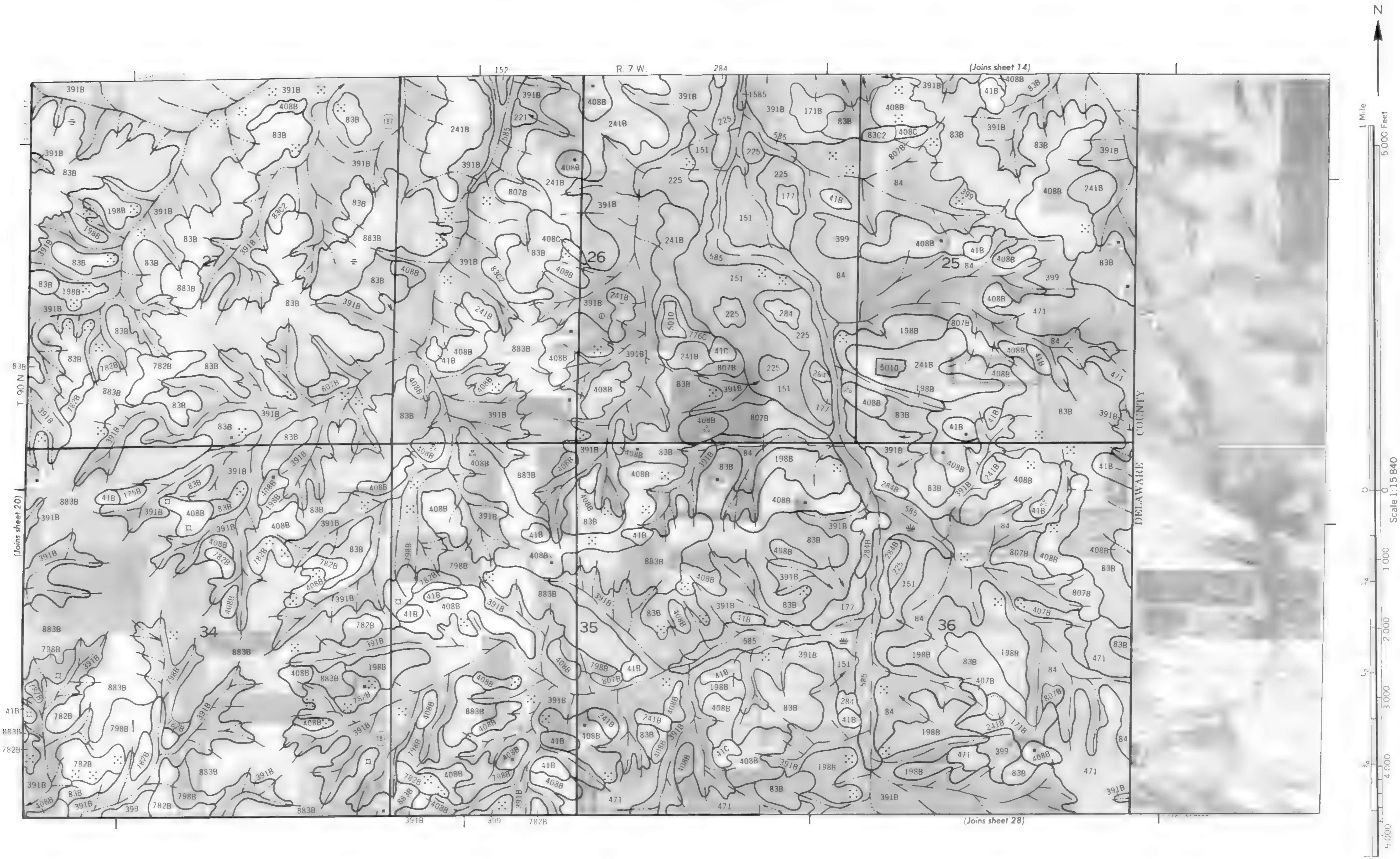

(Joins sheet 10)
R 9 W.
T 90 N.
(Joins sheet 16)
(Joins sheet 18)
(Joins sheet 24)
Bryantsburg
Otter Creek
ROCK ISLAND AND PACIFIC
29
28
27
26
32
33
34
35
N
1 Mile
5 000 Feet
Scale 1:15 840

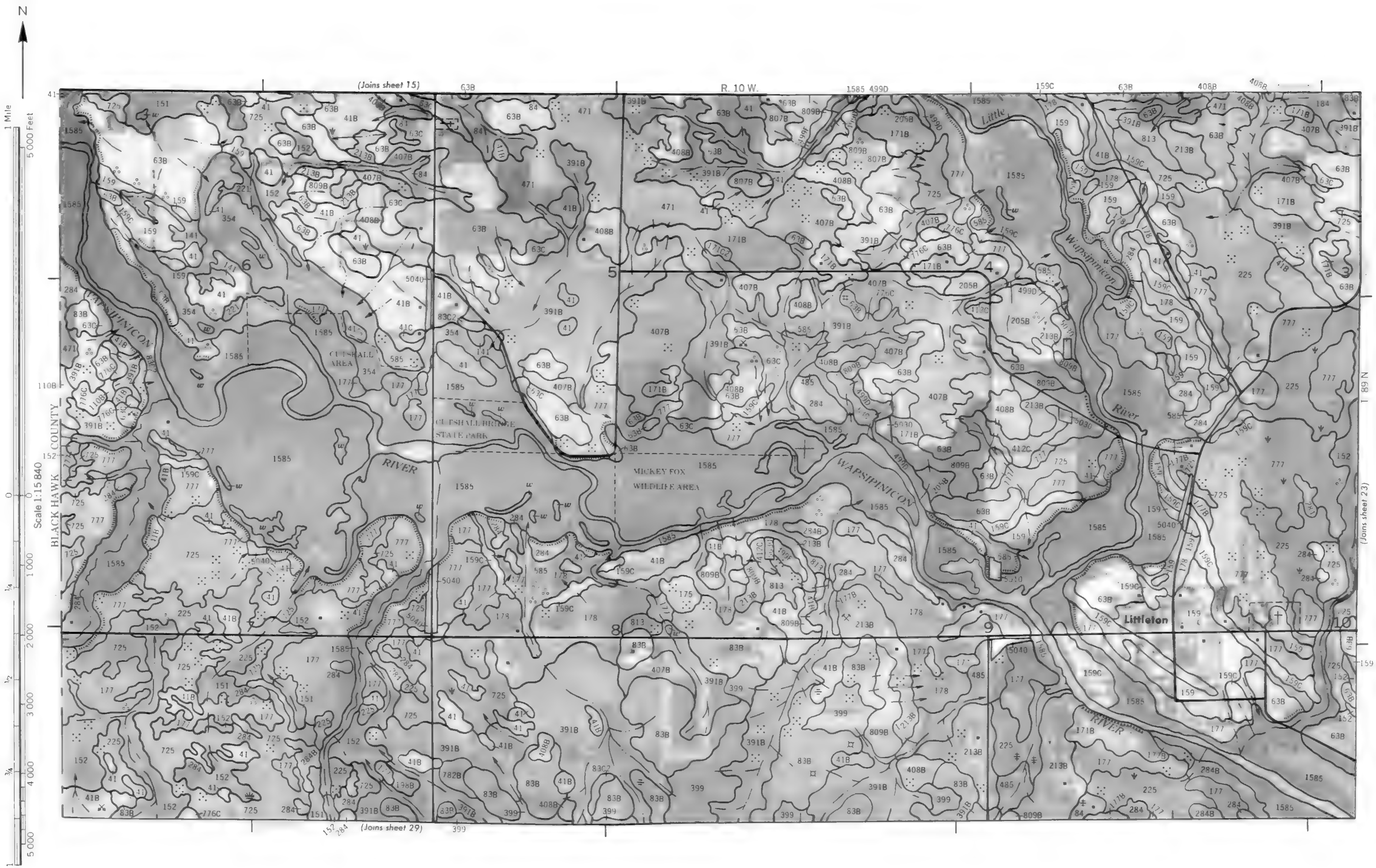

N
(Joins sheet 11)
R. 9 W. | R. 8 W.
(Joins sheet 17)
(Joins sheet 19)
(Joins sheet 25)
T. 90 N
Scale 1:15 840
1 Mile
5 000 Feet
26
25
30
29
35
36
31
32
Creek


19
N
(Joins sheet 12)
R 8 W
T 90 N
(Joins sheet 18)
(Joins sheet 20)
(Joins sheet 26)
28
27
26
25
33
34
35
36
West
Branch
Buffalo
Buffalo
Creek
Branch
East
Buffalo
Creek
1 Mile
5 000 Feet
Scale 1:15 840

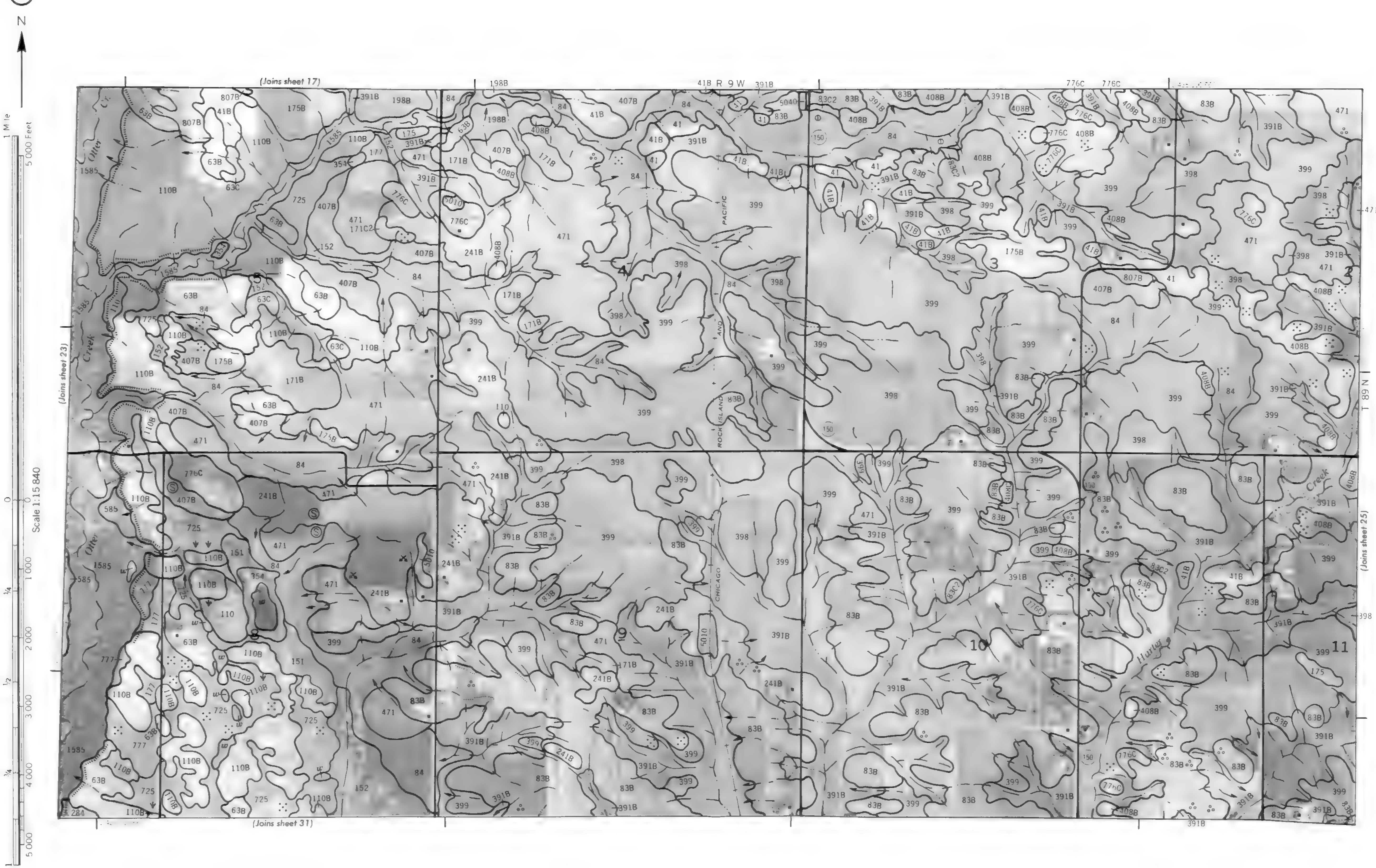
20

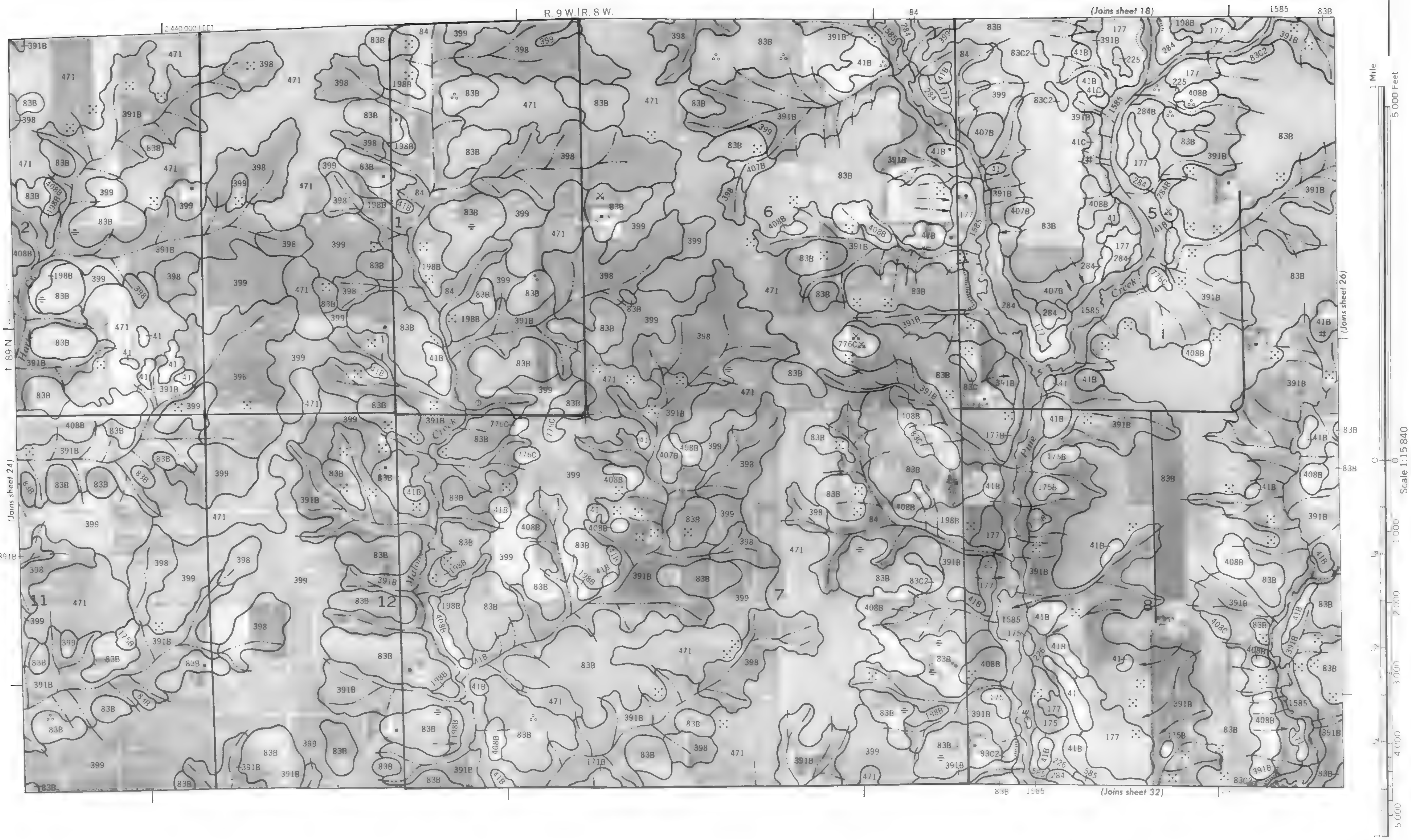

N
1 Mile
5 000 Feet
Scale 1:15 840
R 8 W
R 7 W
(Joins sheet 13)
(Joins sheet 19)
(Joins sheet 21)
(Joins sheet 27)
T 90 N
East Branch Buffalo Creek
25
30
29
28
36
31
32
33

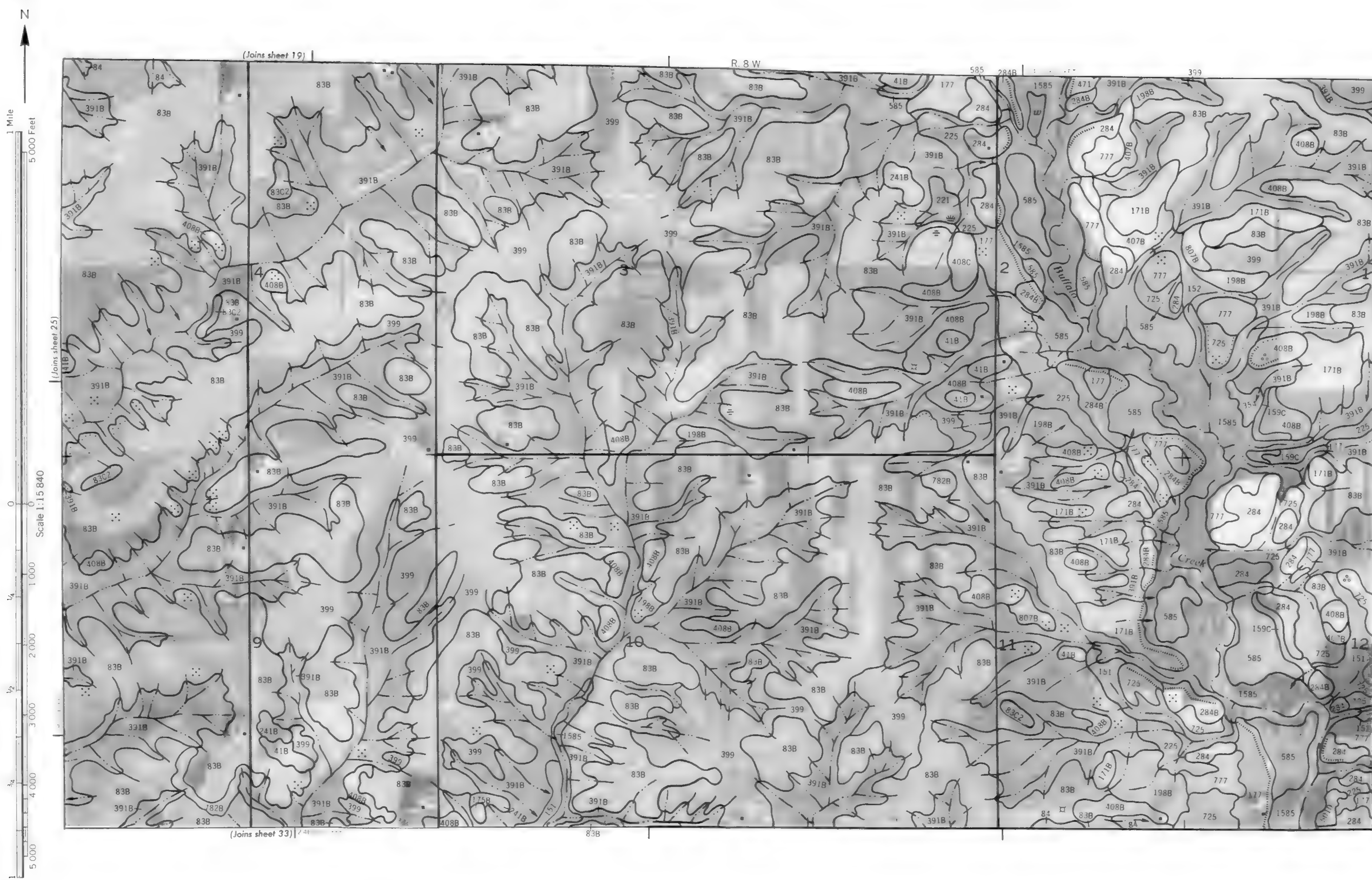

(Joins sheet 14)
R. 7 W.
T. 90 N.
(Joins sheet 20)
(Joins sheet 28)
DELAWARE COUNTY
27
26
25
34
35
36
N
1 Mile
5 000 Feet
Scale 1:15 840

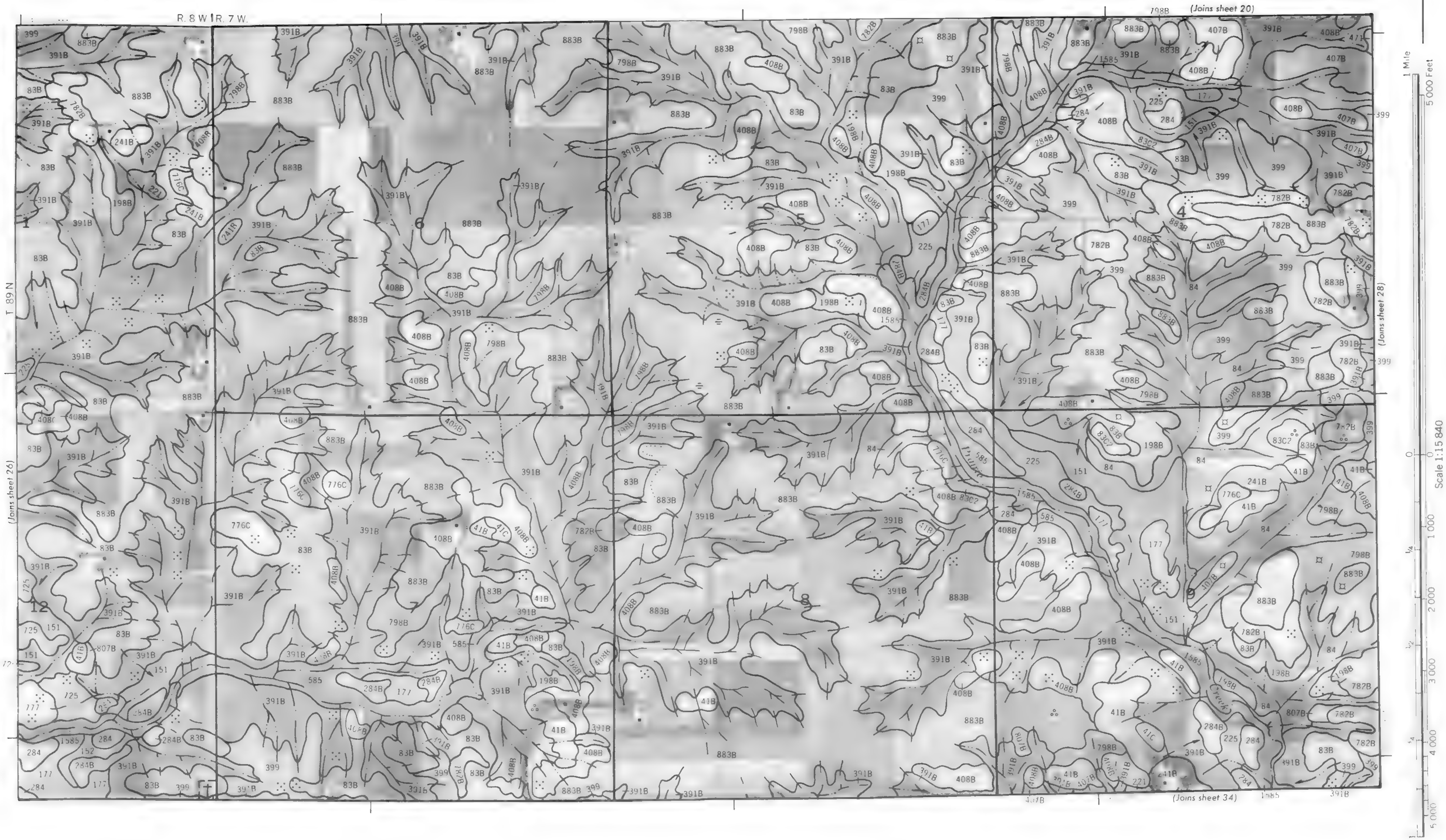

N
1 Mile
5 000 Feet
Scale 1:15 840
BLACK HAWK COUNTY
(Joins sheet 15)
R. 10 W.
T. 89 N.
(Joins sheet 23)
(Joins sheet 29)
CUTSHALL AREA
CUTSHALL BRIDGE STATE PARK
MICKEY FOX WILDLIFE AREA
WAPSIPINICON
RIVER
Little
Wapsipinicon
River
Littleton

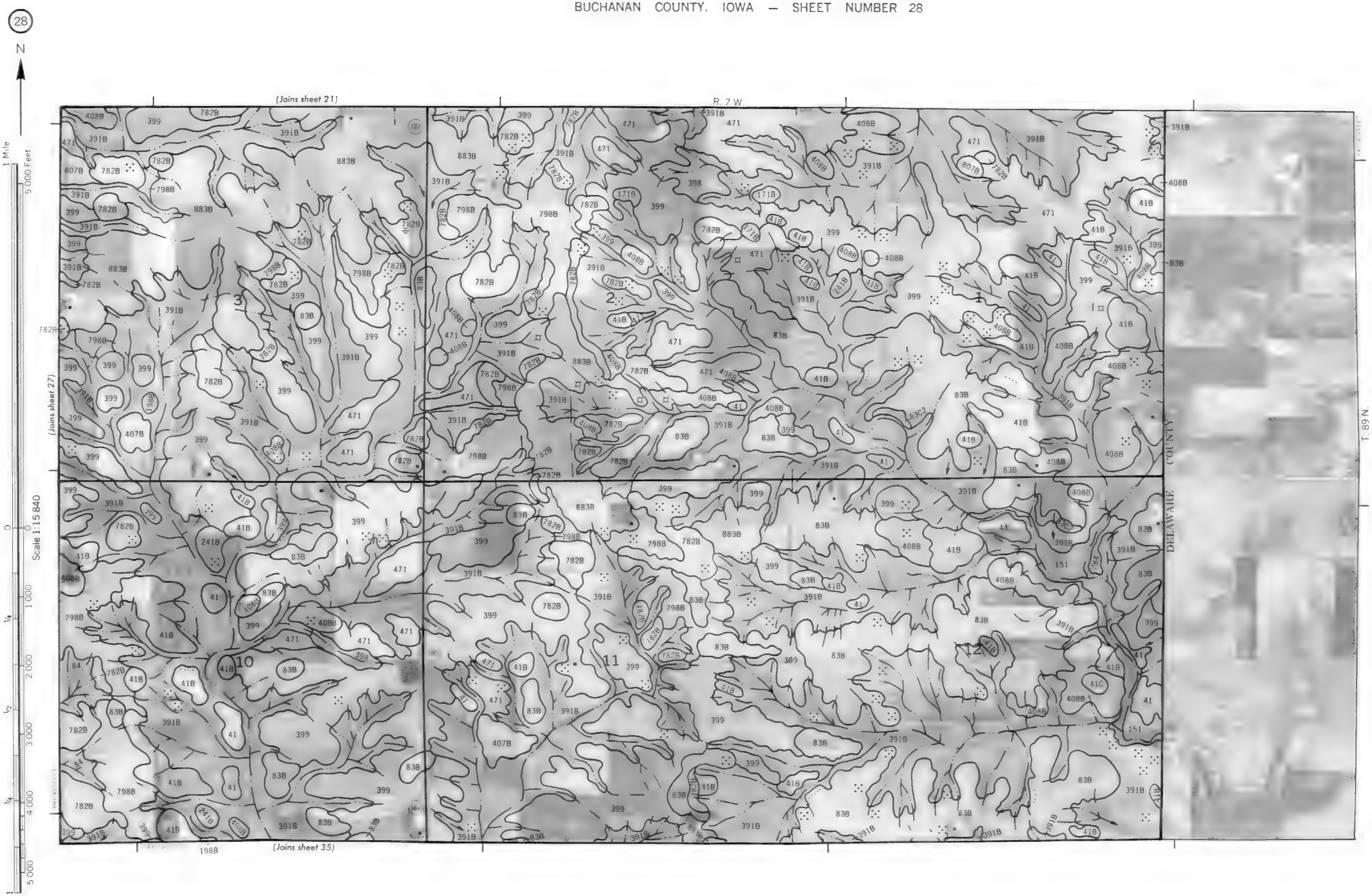

23
N
(Joins sheet 16)
R 10 W | R 9 W
T. 89 N.
(Joins sheet 22)
(Joins sheet 24)
(Joins sheet 30)
Hunter
Otter Creek
1 Mile
5 000 Feet
Scale 1:15 840
0
1 000
2 000
3 000
4 000
5 000

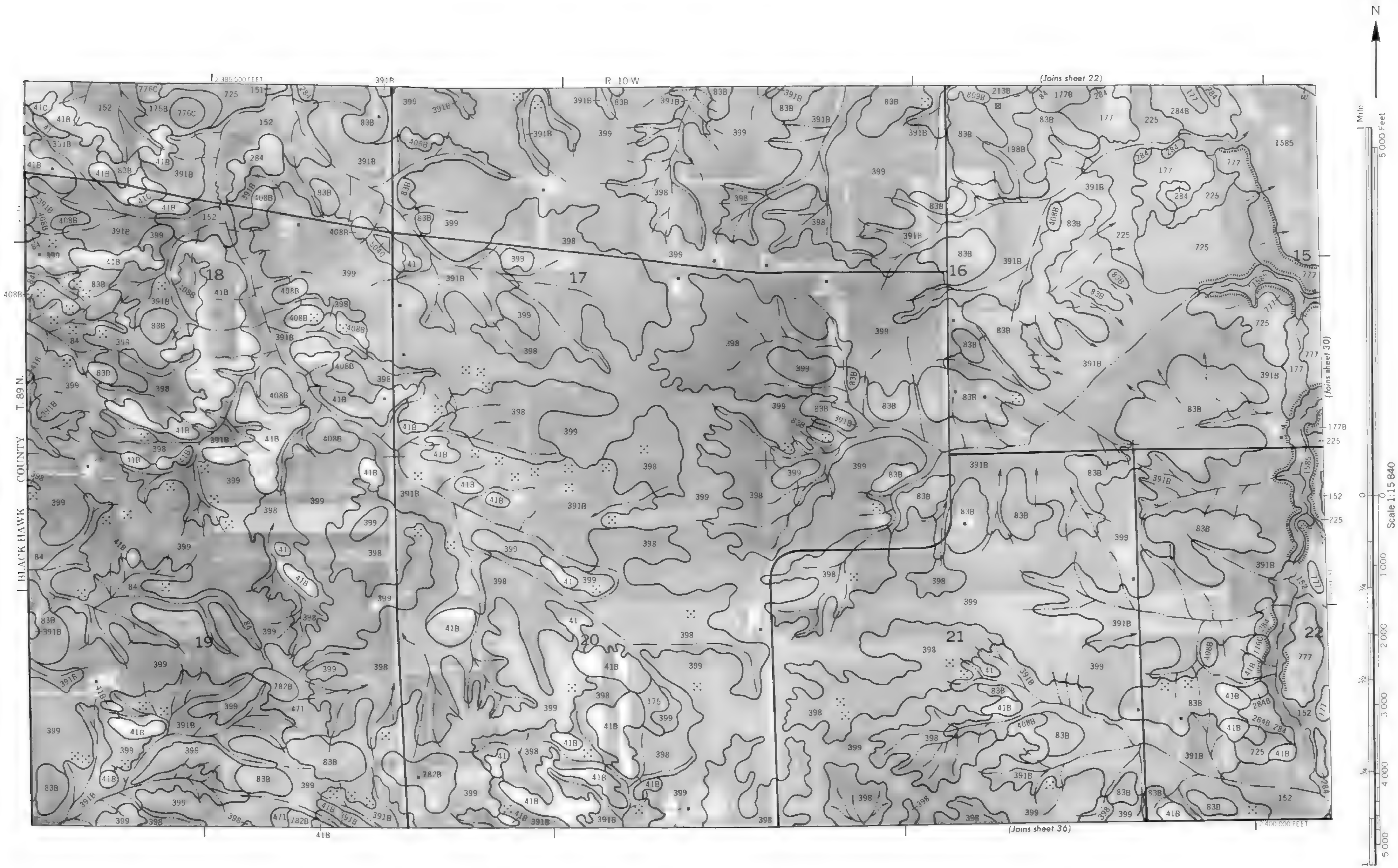

24
N
1 Mile
5 000 Feet
Scale 1:15 840
0
1000
2000
3000
4000
5000
1/4
1/2
3/4
(Joins sheet 17)
(Joins sheet 23)
(Joins sheet 25)
(Joins sheet 31)
R 9 W
T 89 N
Otter Creek
Creek
Hunter
CHICAGO ROCK ISLAND AND PACIFIC
4
3
2
9
10
11


N
R. 9 W. | R. 8 W.
2 440 000 FEET
(Joins sheet 18)
(Joins sheet 24)
(Joins sheet 26)
(Joins sheet 32)
T. 89 N.
1 Mile
5 000 Feet
Scale 1:15 840

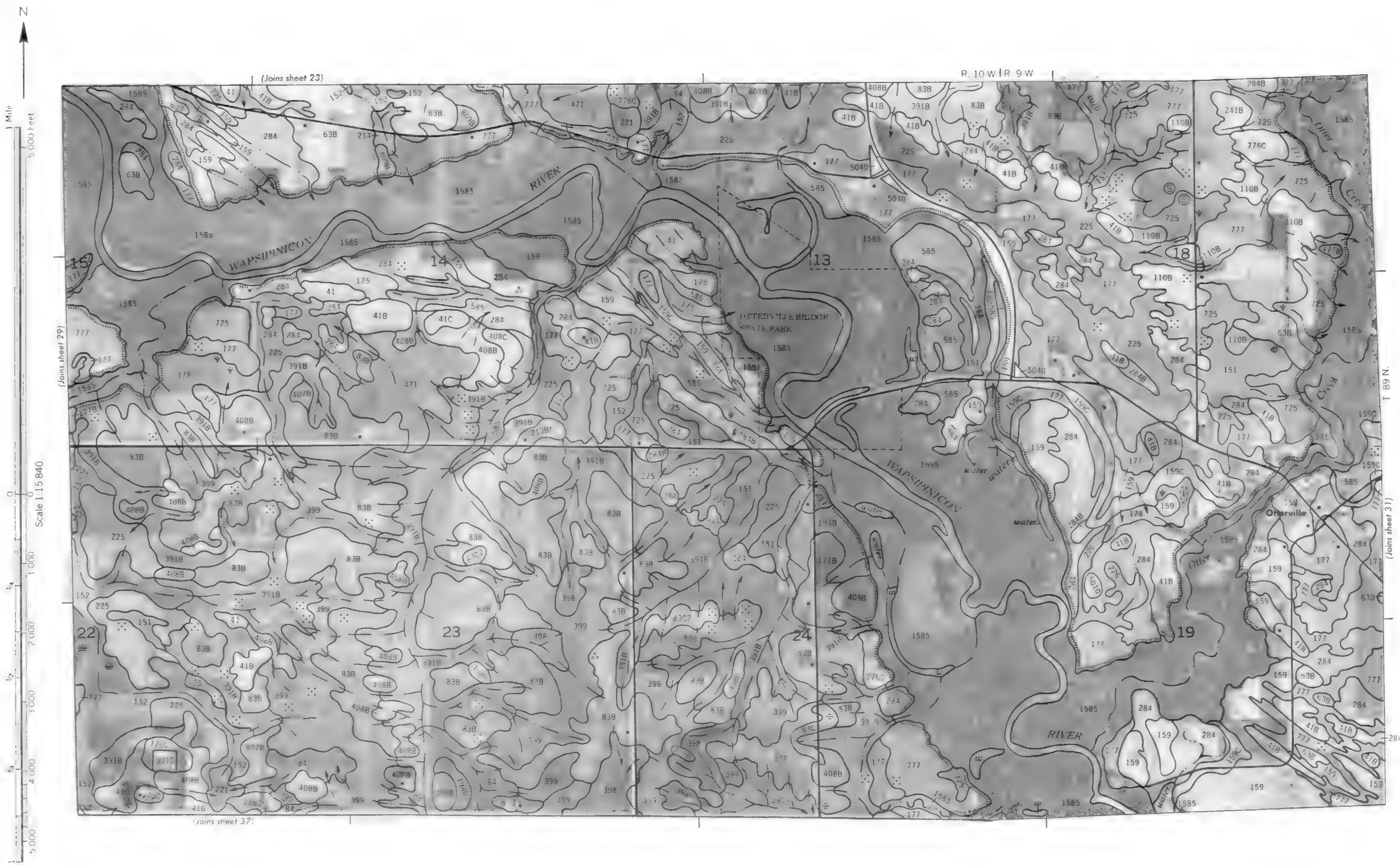

N
(Joins sheet 19)
R. 8 W.
T 89 N.
(Joins sheet 25)
(Joins sheet 27)
(Joins sheet 33)
Buffalo
Creek
1 Mile
5 000 Feet
Scale 1:15 840

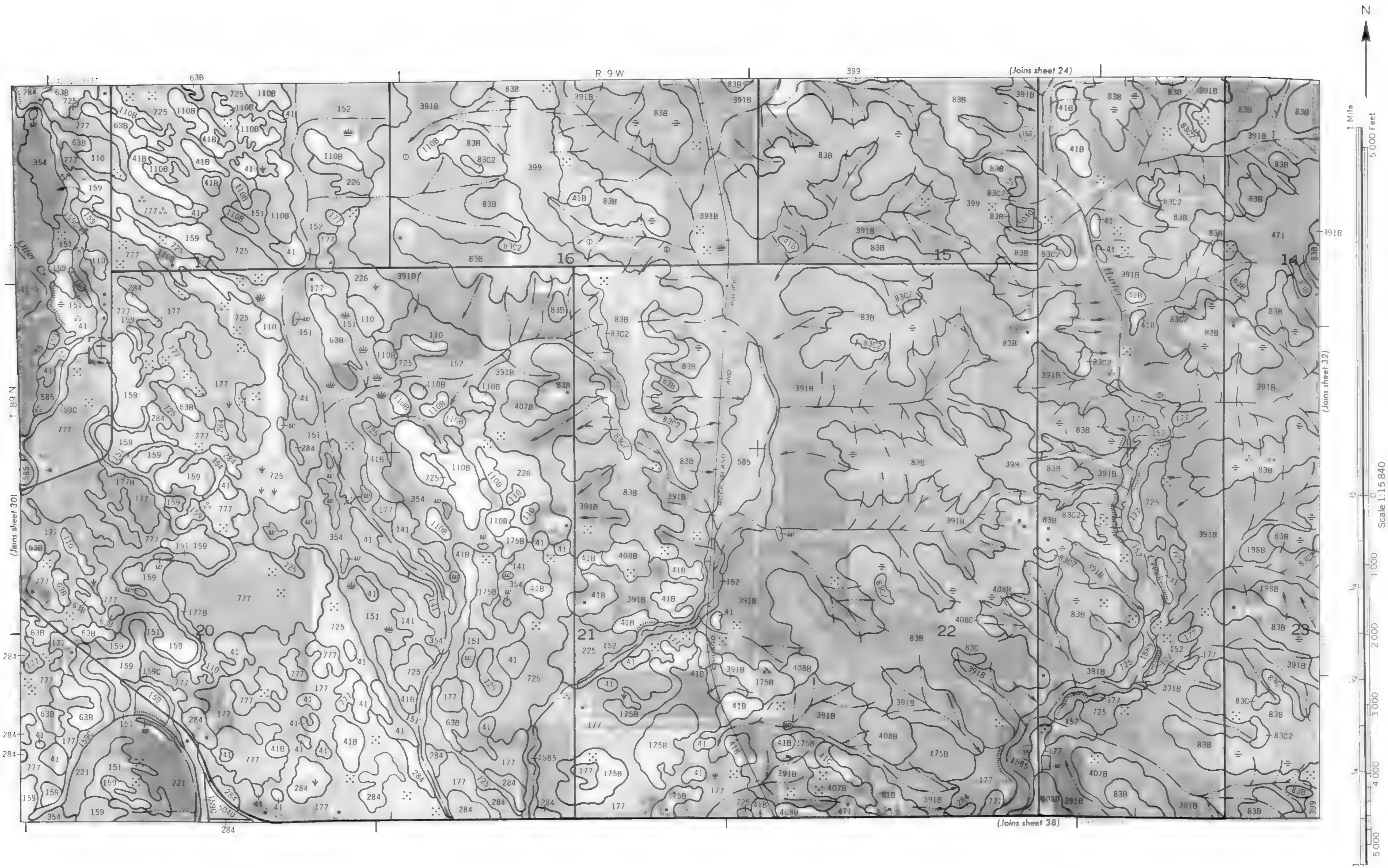

R. 8 W. R. 7 W.
T. 89 N.
(Joins sheet 20)
(Joins sheet 26)
(Joins sheet 28)
(Joins sheet 34)
1
6
5
4
12
8
9
N
1 Mile
5 000 Feet
Scale 1:15 840


28
N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 21)
R. 7 W.
(Joins sheet 27)
(Joins sheet 35)
DELAWARE COUNTY
T. 89 N.

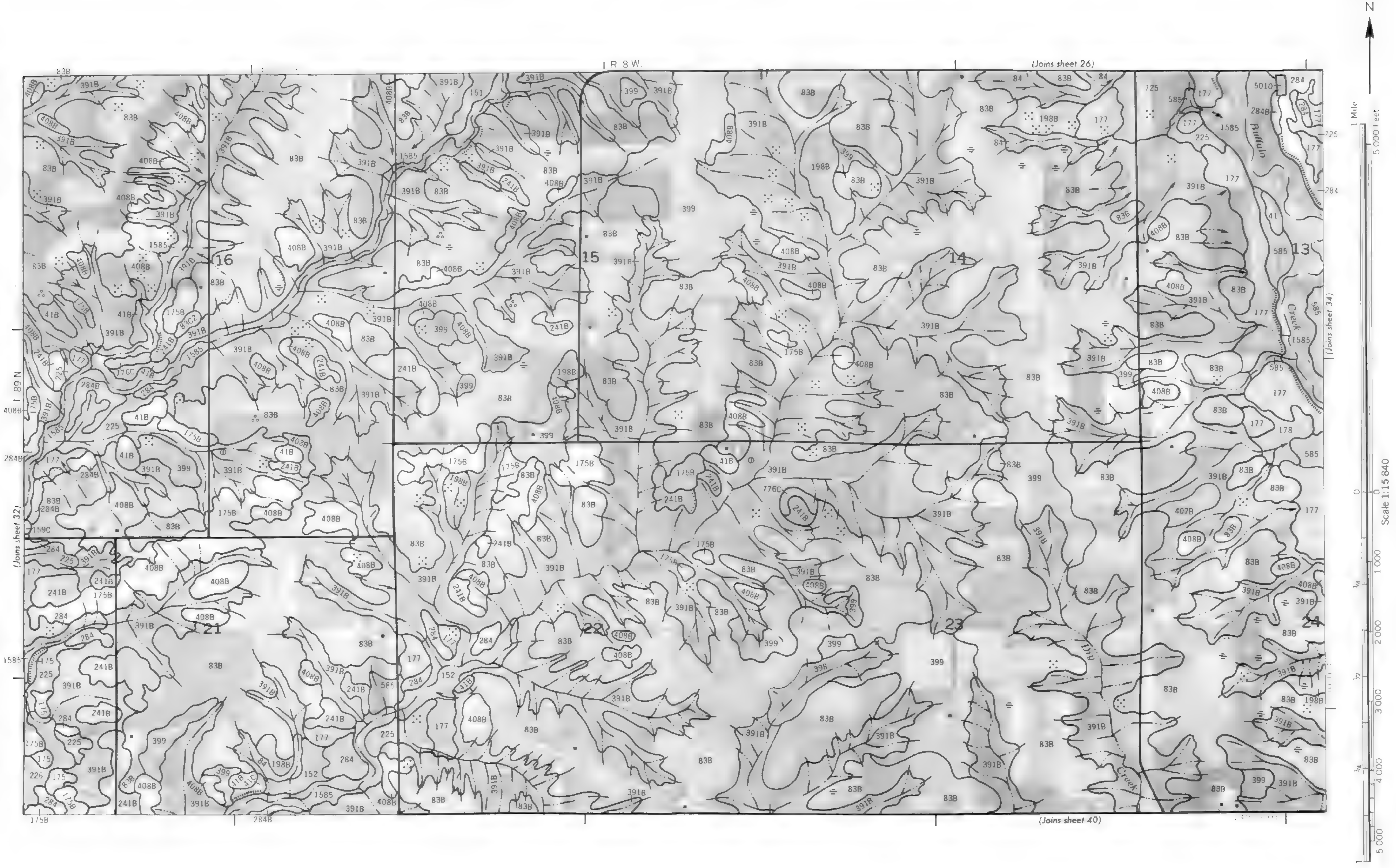

N
(Joins sheet 22)
R. 10 W.
T. 89 N.
BLACK HAWK COUNTY
(Joins sheet 30)
(Joins sheet 36)
2 385 000 FEET
2 400 000 FEET
15
16
17
18
19
20
21
22
1 Mile
5 000 Feet
Scale 1:15 840

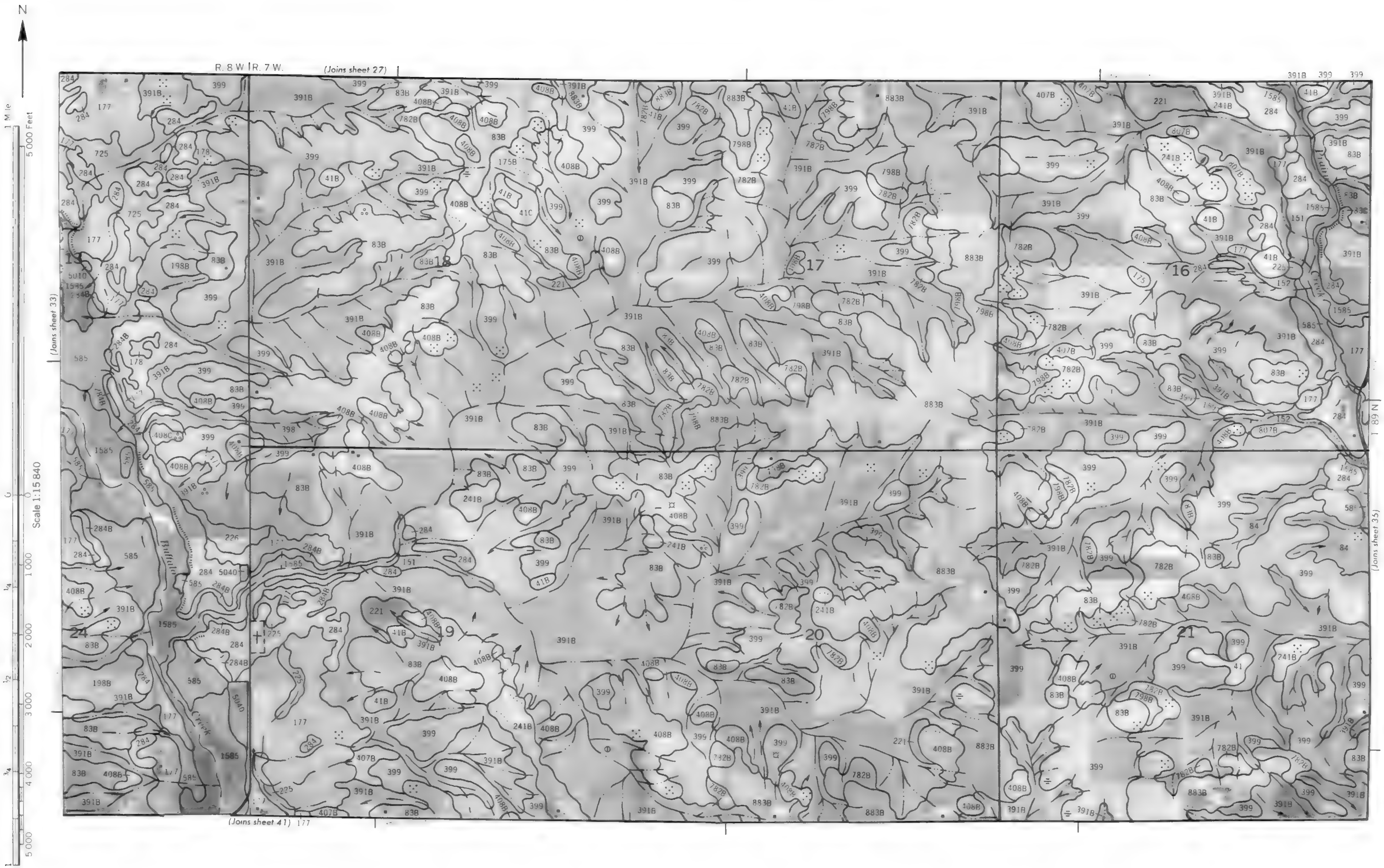
30

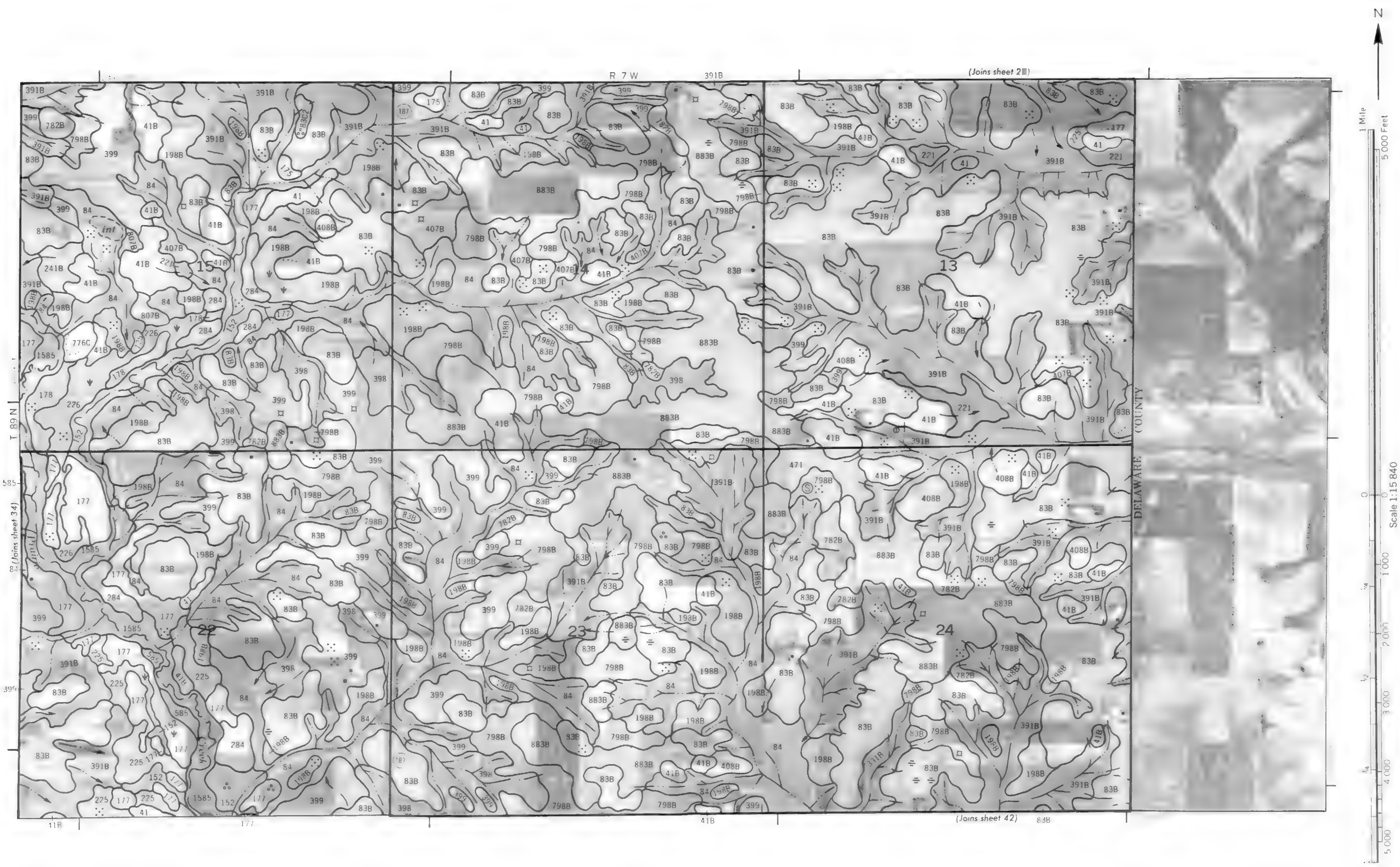

N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 23)
R. 10 W | R. 9 W
(Joins sheet 29)
(Joins sheet 31)
(Joins sheet 37)
T. 89 N.
WAPSIPINICON RIVER
OTTERVILLE BRIDGE STATE PARK
WAPSIPINICON
RIVER
Otterville
Otter Creek
water
14
13
15
18
22
23
24
19


N
R 9 W
(Joins sheet 24)
(Joins sheet 32)
(Joins sheet 38)
(Joins sheet 30)
T 89 N
Otter Cr.
Hunter
ROCK ISLAND AND PACIFIC
CHICAGO
16
15
14
21
22
23
20
1 Mile
5 000 Feet
Scale 1:15 840


N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 25)
R. 9 W. | R. 8 W.
(Joins sheet 31)
(Joins sheet 33)
T. 89 N.
(Joins sheet 39)
Pine
Creek
Malone
14
13
18
17
23
24
19
20

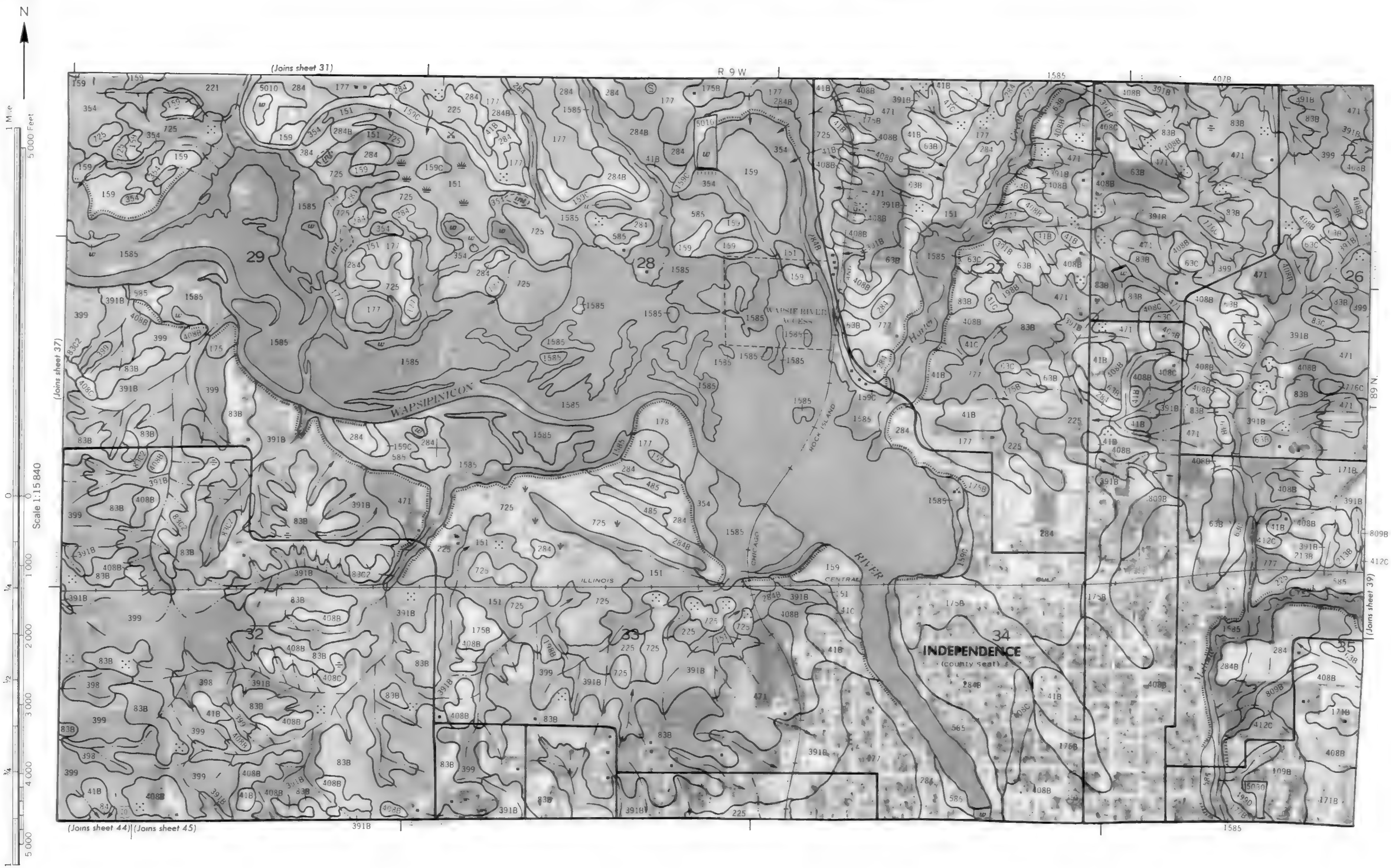

N
R 8 W.
(Joins sheet 26)
(Joins sheet 34)
(Joins sheet 40)
(Joins sheet 32)
T 89 N
16
15
14
13
21
22
23
24
Buffalo Creek
Dry Creek
1 Mile
5 000 Feet
Scale 1:15 840
0
1 000
2 000
3 000
4 000
5 000
1/4
1/2
3/4

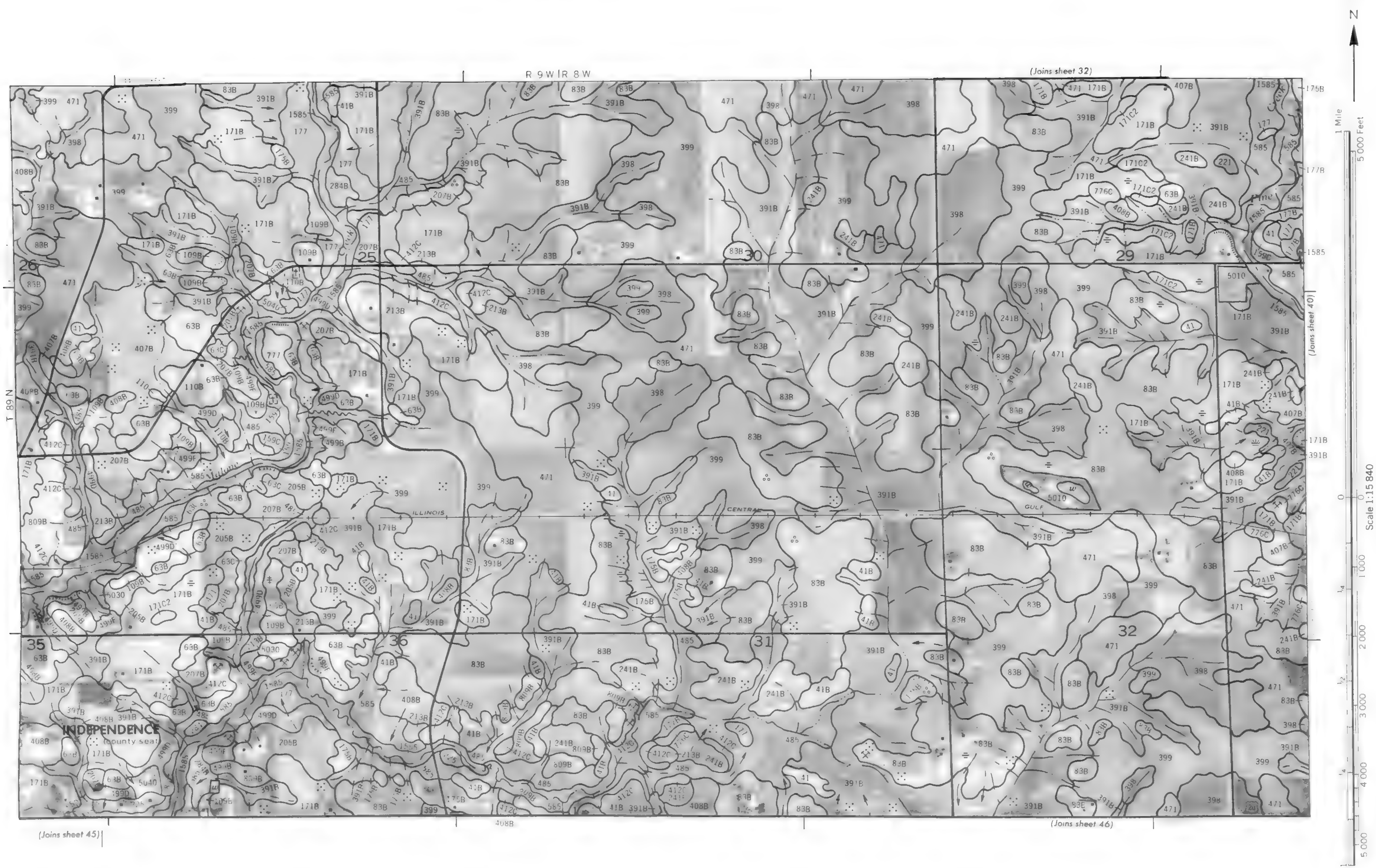

N
1 Mile
5 000 Feet
Scale 1:15 840
R. 8 W. | R. 7 W.
(Joins sheet 27)
(Joins sheet 33)
(Joins sheet 35)
(Joins sheet 41)
T. 89 N.
13
18
17
16
24
19
20
21
Buffalo
Creek


N
(Joins sheet 28)
R 7 W
T 89 N
(Joins sheet 34)
(Joins sheet 42)
DELAWARE COUNTY
15
14
13
22
23
24
1 Mile
5 000 Feet
Scale 1:15 840
0
1 000
2 000
3 000
4 000
5 000

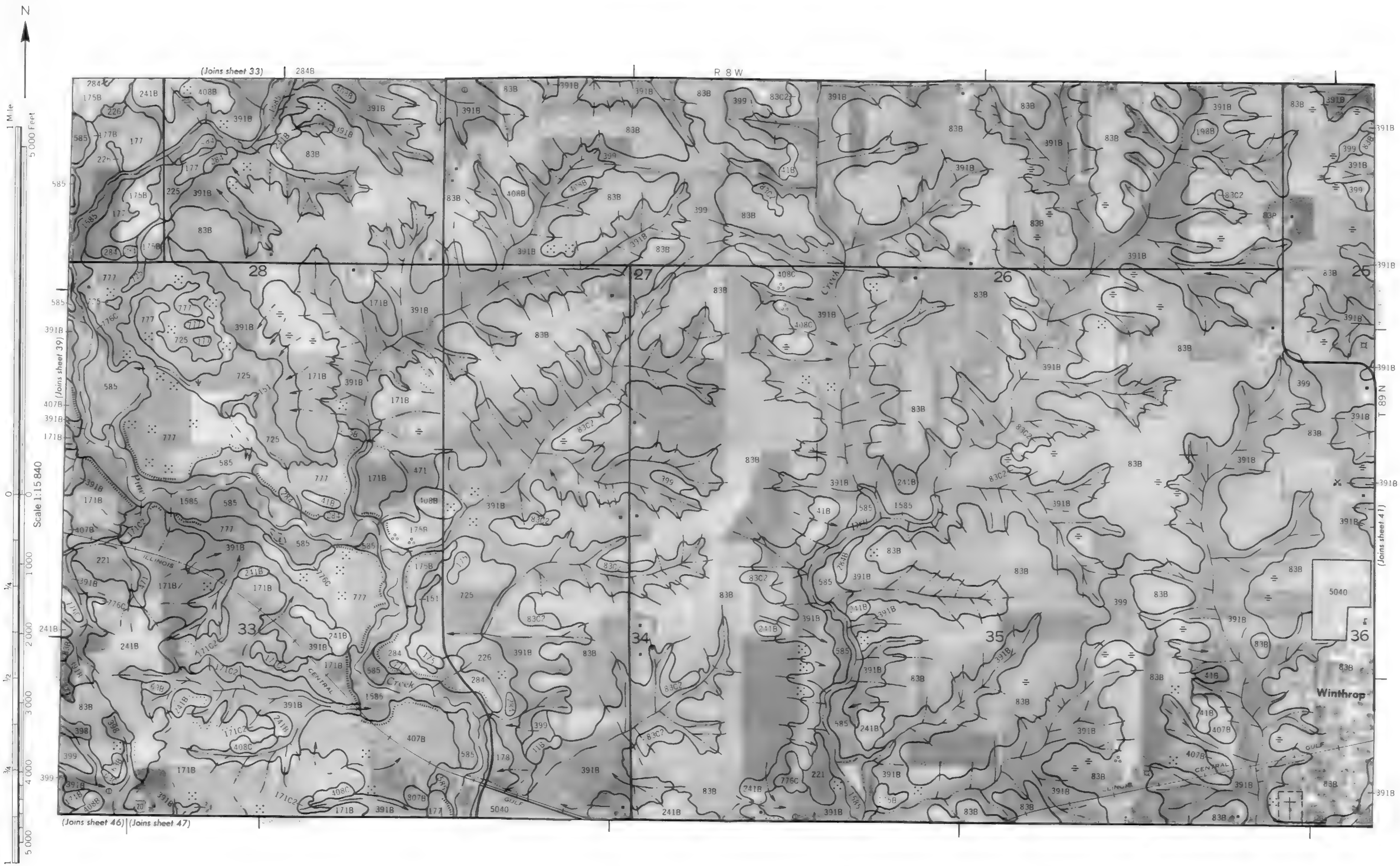

36
N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 29)
R 10 W
T. 89 N.
(Joins sheet 37)
(Joins sheet 43)
BLACK HAWK COUNTY
BLACK HAWK COUNTY
JESUP
ILLINOIS
CENTRAL
GULF
30
29
28
27
31
32
33
34


N
R. 10 W. | R. 9 W.
(Joins sheet 30)
(Joins sheet 36)
(Joins sheet 38)
(Joins sheet 43)
(Joins sheet 44)
(Joins sheet 44)
T. 89 N.
WAPSIPINICON RIVER
ILLINOIS CENTRAL GULF
27
26
25
30
34
35
36
31
1 Mile
5 000 Feet
Scale 1:15 840

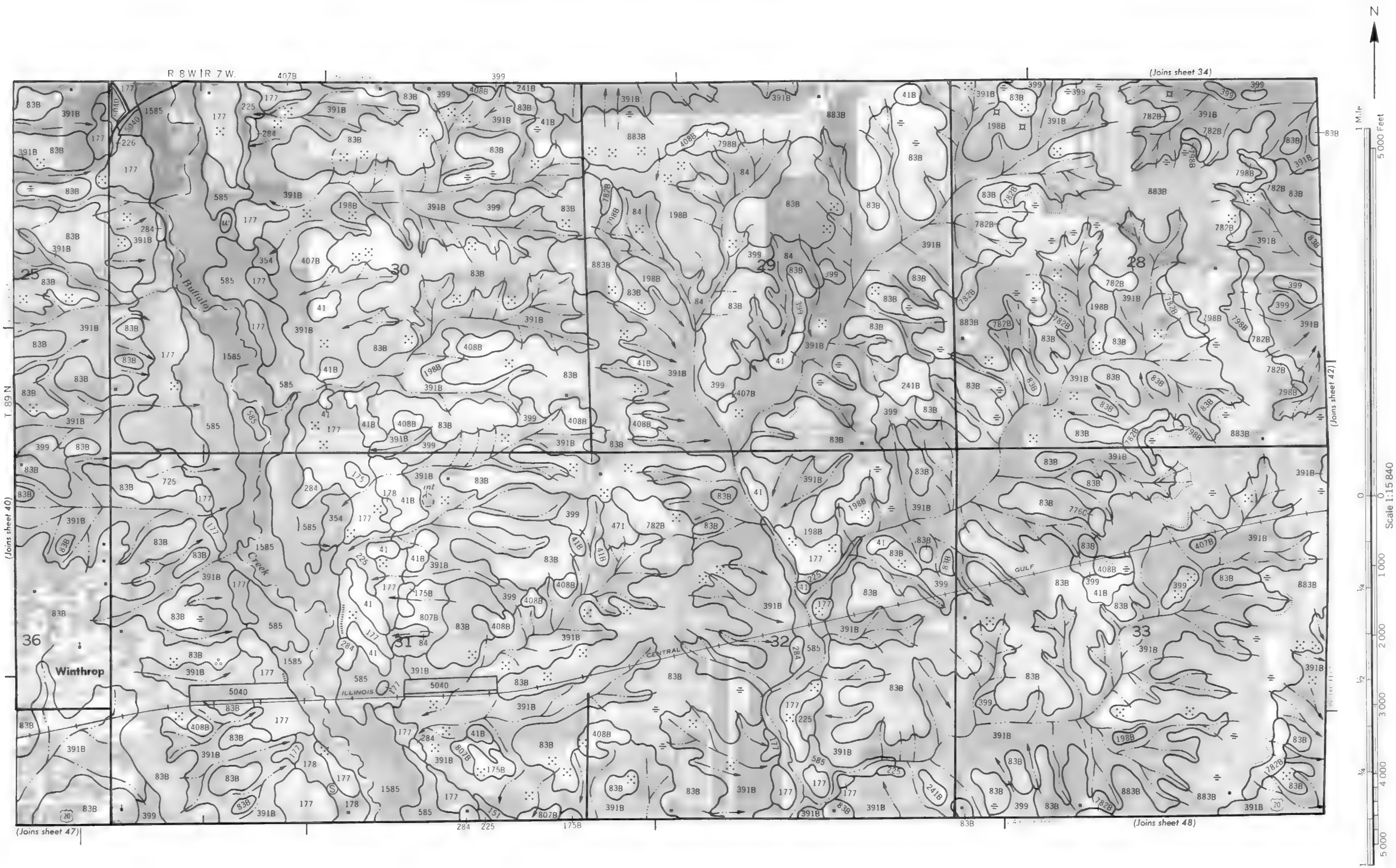

N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 31)
R 9 W
(Joins sheet 37)
(Joins sheet 39)
(Joins sheet 44)
(Joins sheet 45)
T 89 N.
WAPSIPINICON
RIVER
WAPSIE RIVER ACCESS
INDEPENDENCE
(county seat)
ILLINOIS
CENTRAL
CHICAGO
ROCK ISLAND
29
28
26
32
33
34
35


39
N
(Joins sheet 32)
R 9 W | R 8 W
T 89 N
(Joins sheet 40)
(Joins sheet 45)
(Joins sheet 46)
INDEPENDENCE
(county seat)
ILLINOIS
CENTRAL
GULF
26
25
30
29
35
36
31
32
Scale 1:15 840
1 Mile
5 000 Feet
0
1 000
2 000
3 000
4 000
5 000

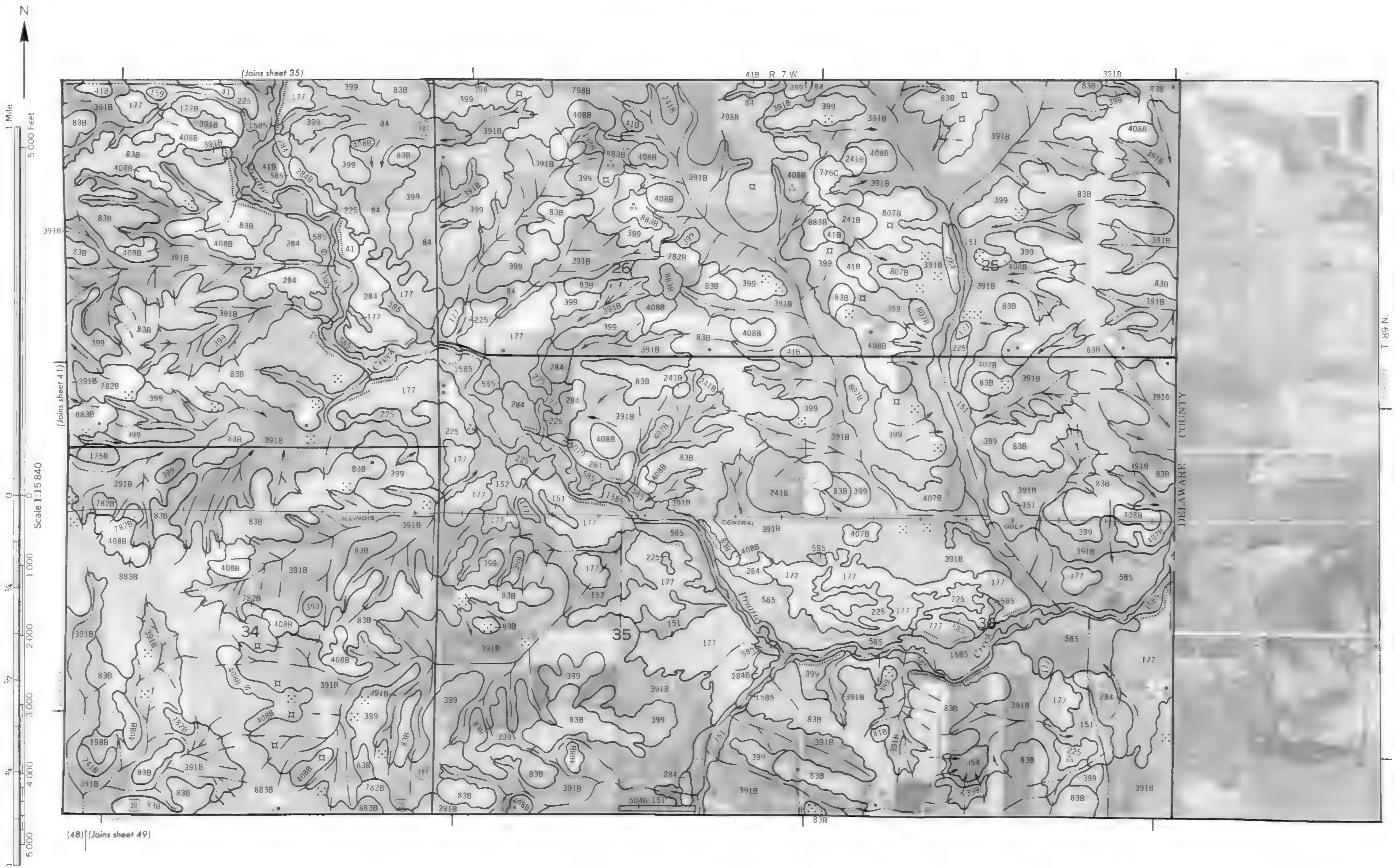
BUCHANAN COUNTY, IOWA — SHEET NUMBER 40



BUCHANAN COUNTY, IOWA — SHEET NUMBER 41

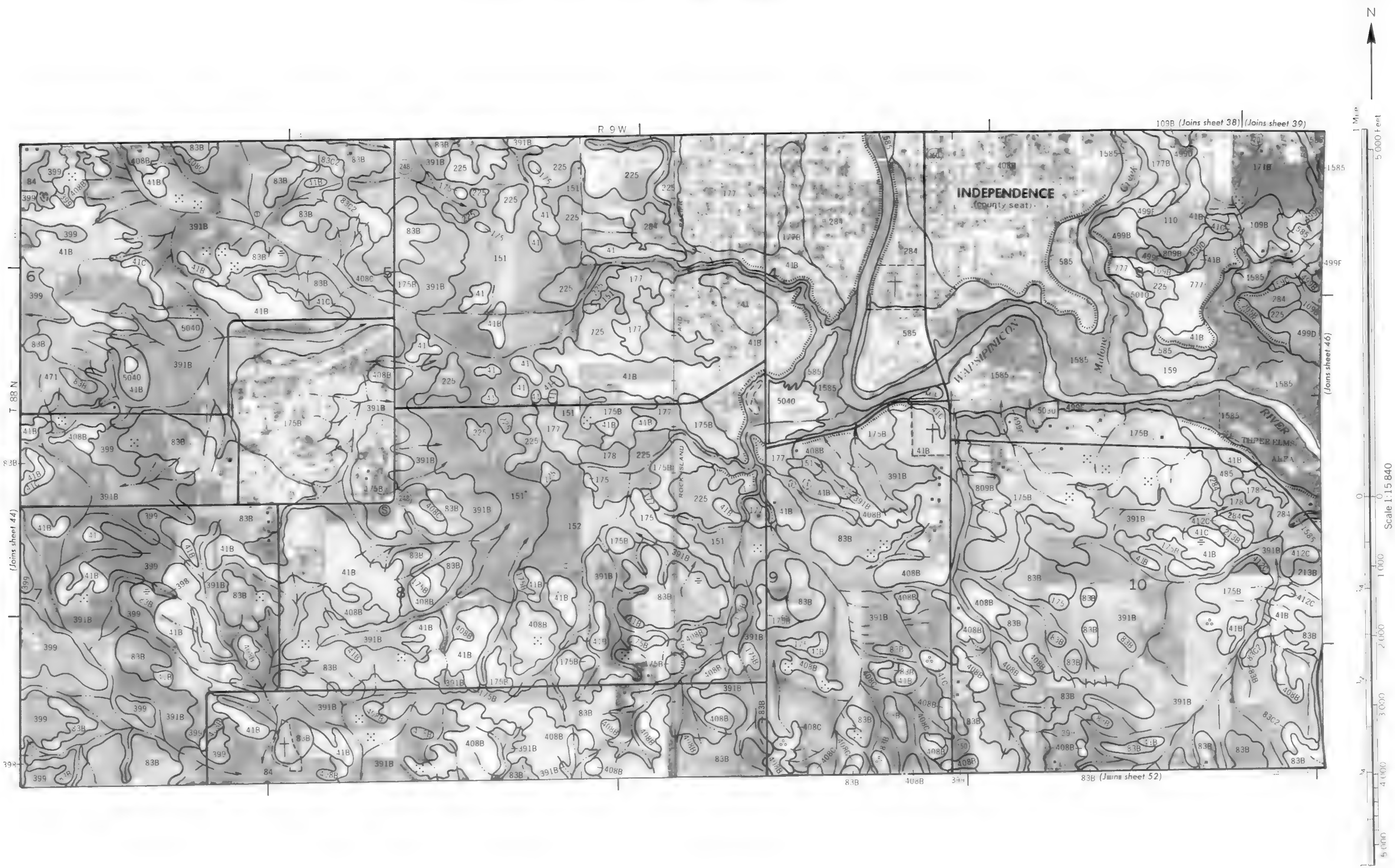


BUCHANAN COUNTY, IOWA — SHEET NUMBER 42



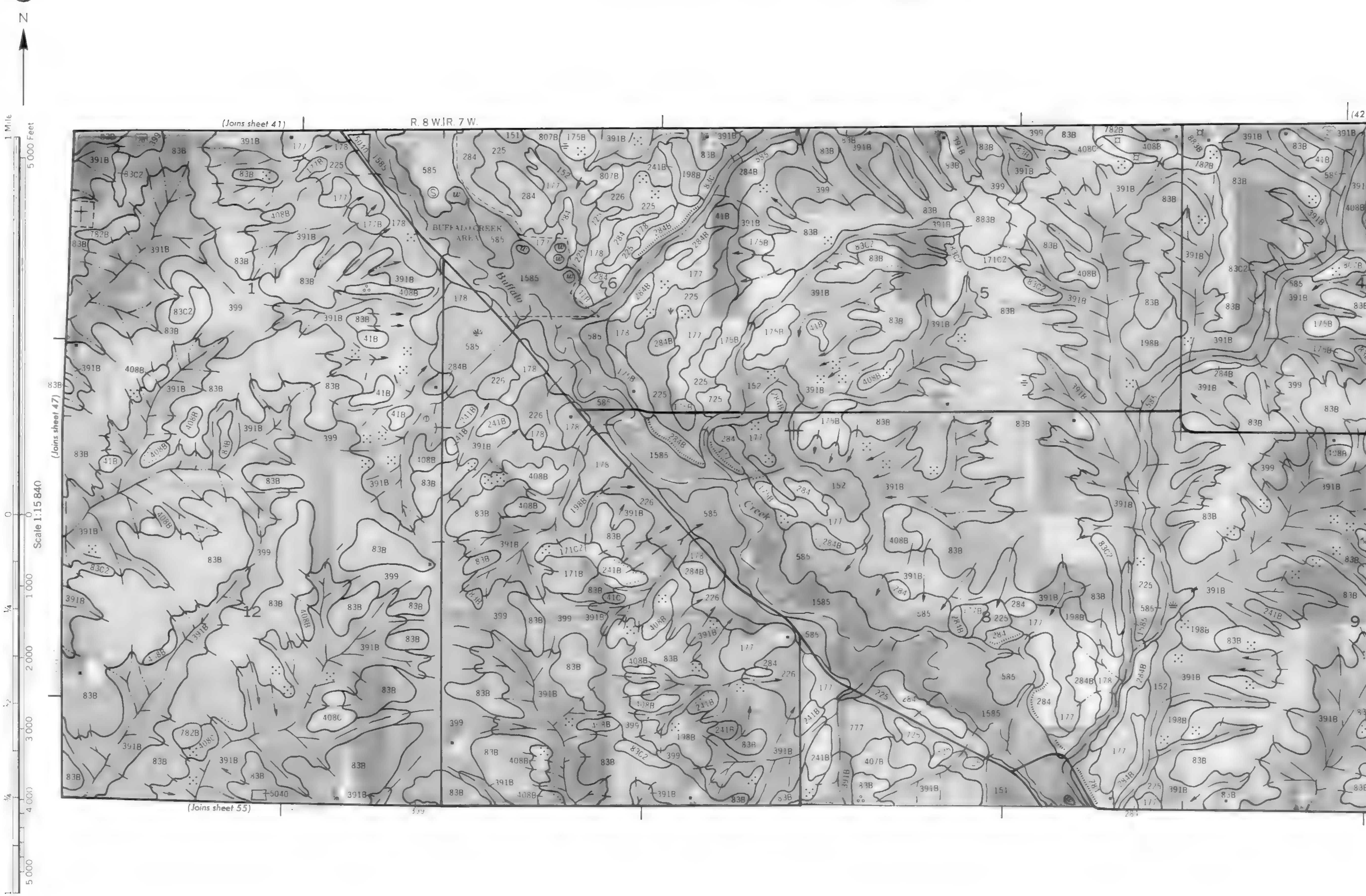

N
R. 10 W.
T. 88 N.
(Joins sheet 36)
(Joins sheet 37)
(Joins sheet 44)
(Joins sheet 50)
BLACK HAWK COUNTY
E. Spring Cr.
1 Mile
5 000 Feet
Scale 1:15 840

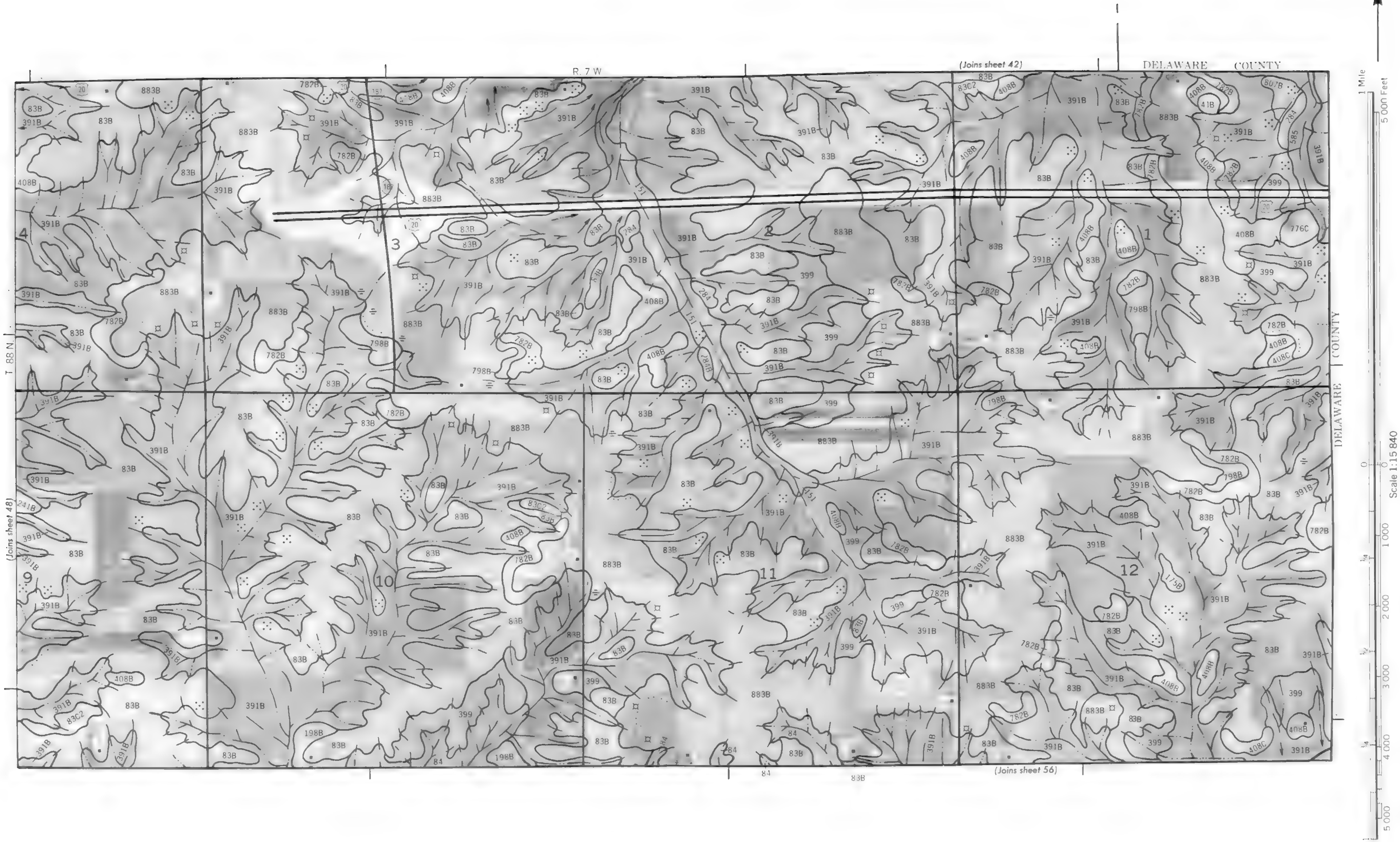

N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 37)
(Joins sheet 38)
(Joins sheet 43)
(Joins sheet 45)
(Joins sheet 51)
R. 10 W. | R. 9 W.
T. 88 N.
Creek
Lime
INDEPENDENCE MUNICIPAL AIRPORT

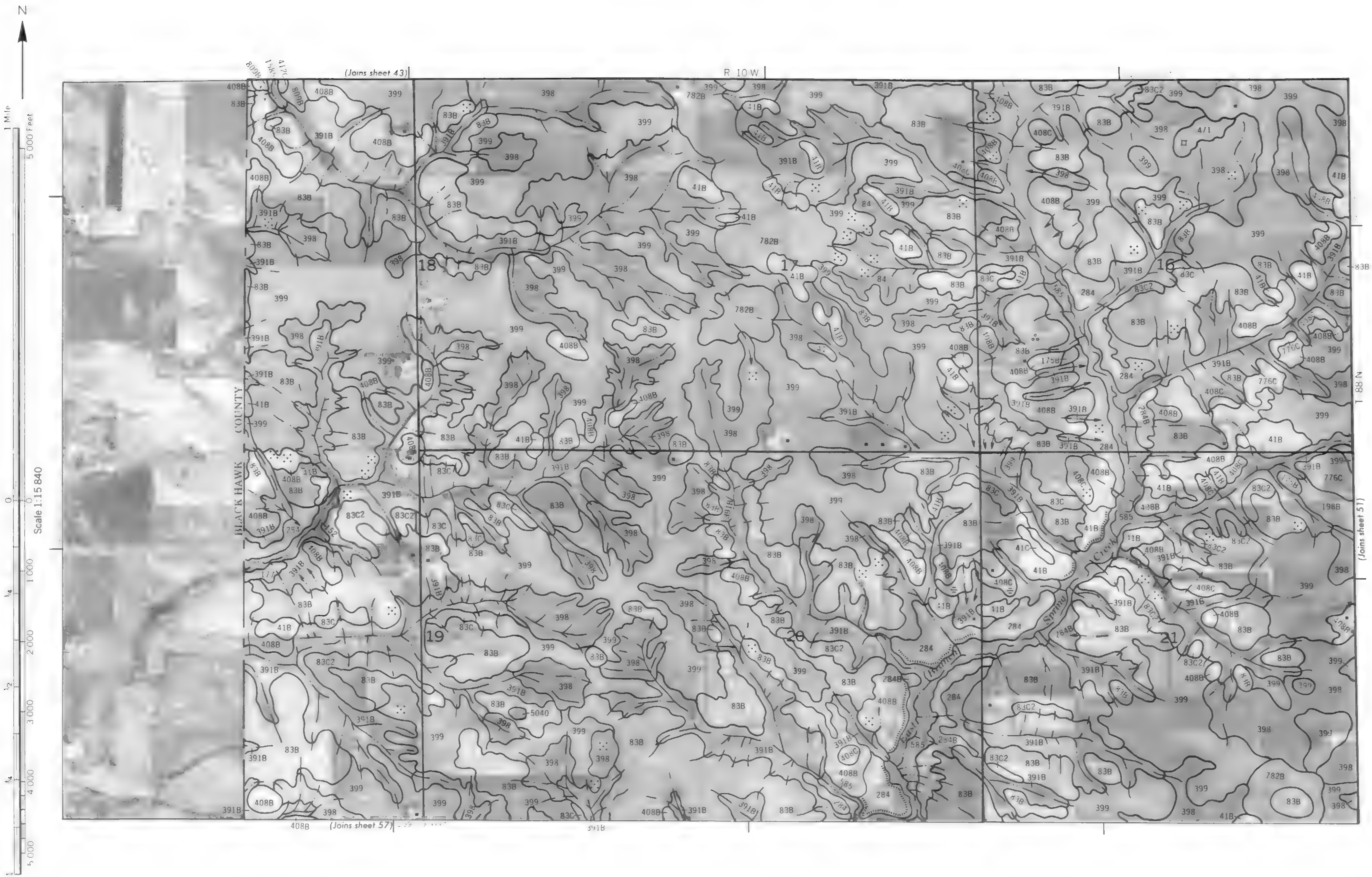

N
R 9 W
T 88 N
109B (Joins sheet 38) (Joins sheet 39)
(Joins sheet 44)
(Joins sheet 46)
83B (Joins sheet 52)
INDEPENDENCE
(county seat)
WAPSIPINICON
RIVER
Malone
Creek
ROCK ISLAND
THREE ELMS AREA
1 Mile
5 000 Feet
Scale 1:15 840

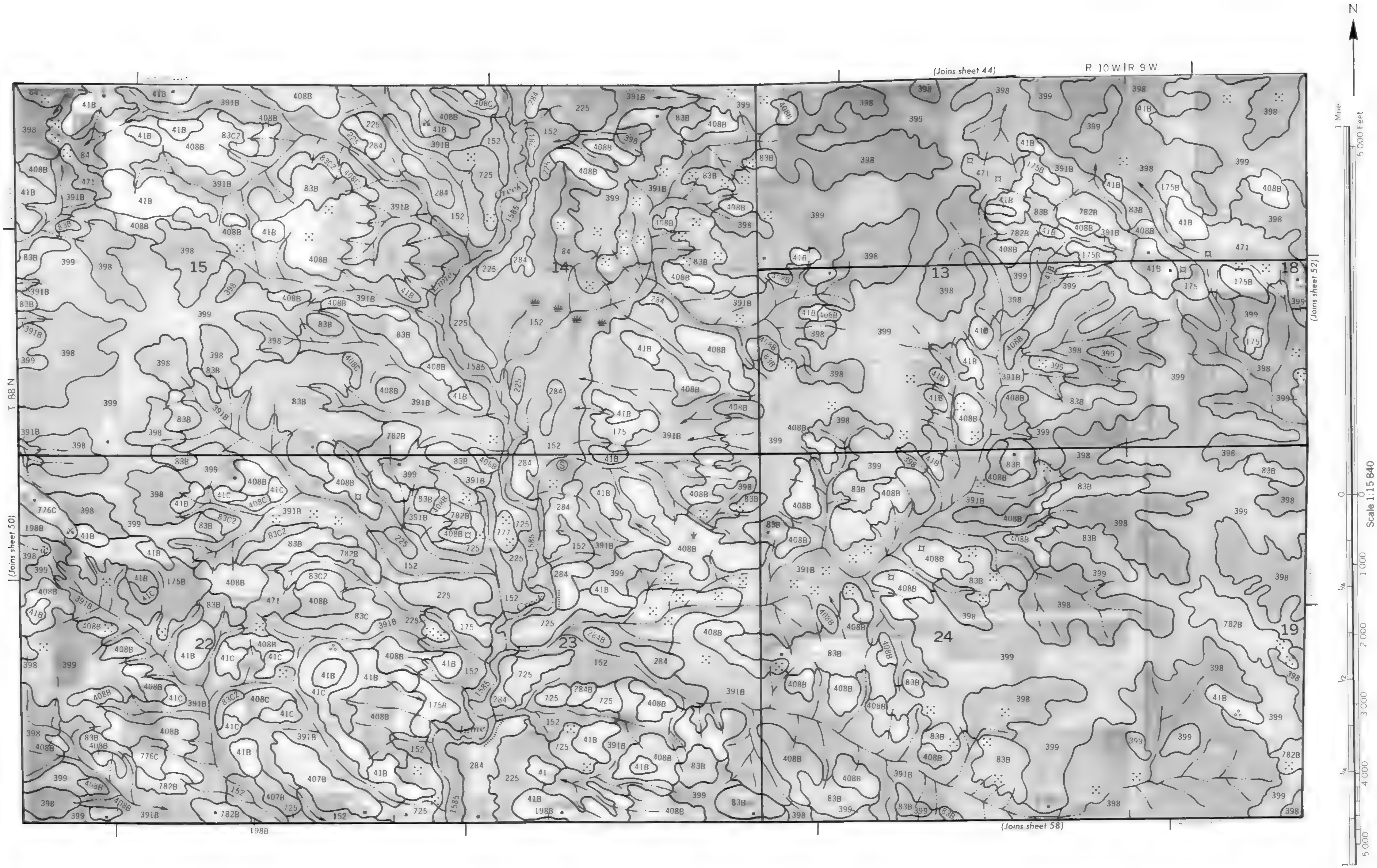

N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 39)
R. 9 W. | R. 8 W.
(Joins sheet 40)
(Joins sheet 45)
(Joins sheet 47)
(Joins sheet 53)
T. 88 N.
THREE ELMS AREA
WAPSIPINICON
RIVER


N
(Joins sheet 40)
(Joins sheet 41)
R 8 W
T 88 N
(Joins sheet 46)
(Joins sheet 48)
(Joins sheet 54)
1 Mile
5 000 Feet
Scale 1:15 840


N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 41)
R. 8 W.|R. 7 W.
(42)
(Joins sheet 47)
(Joins sheet 49)
(Joins sheet 55)
T. 88 N.
BUFFALO CREEK AREA
Buffalo Creek

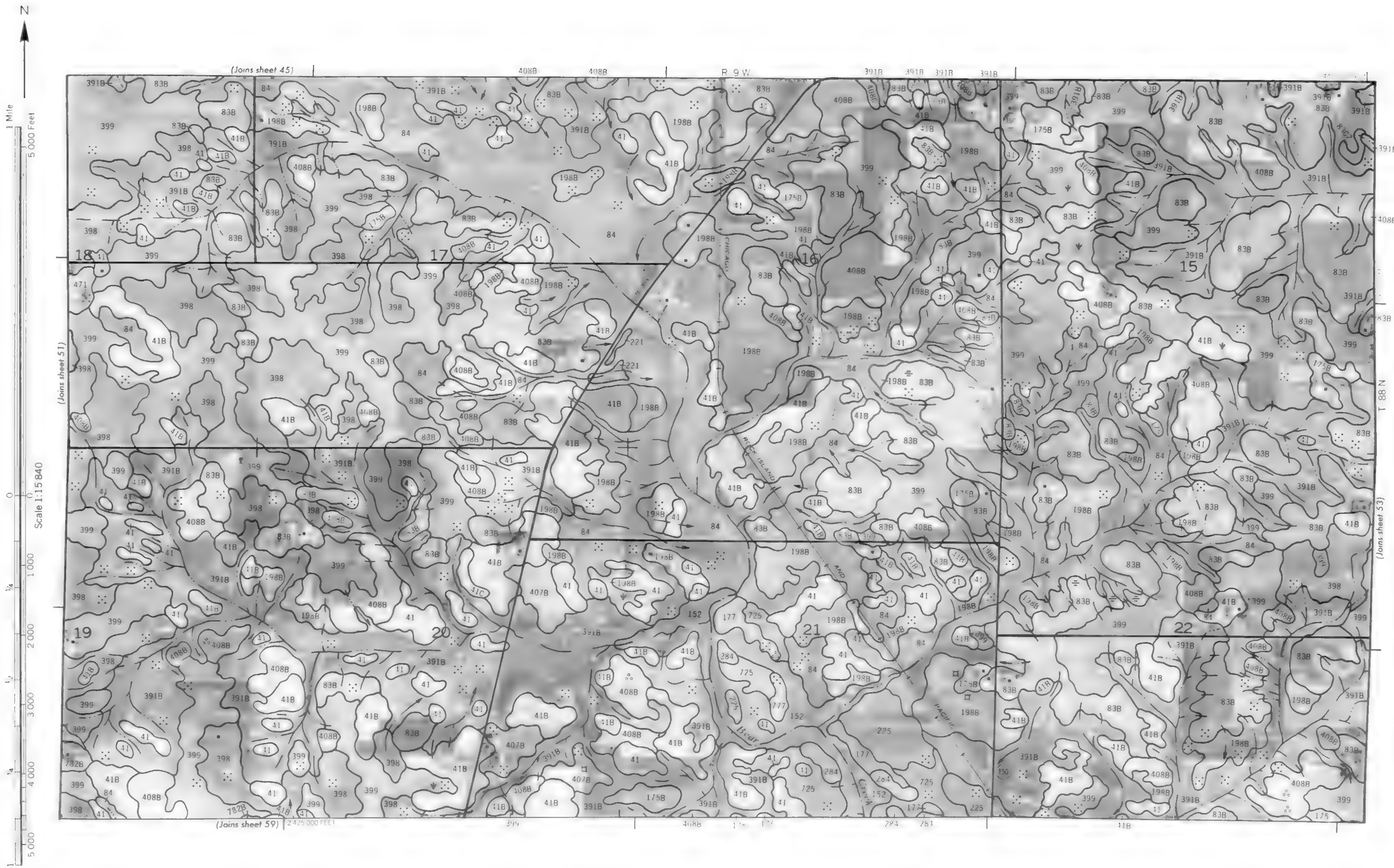

N
R. 7 W.
(Joins sheet 42)
DELAWARE COUNTY
T. 88 N.
(Joins sheet 48)
(Joins sheet 56)
DELAWARE COUNTY
1
2
3
4
9
10
11
12
Scale 1:15 840
1 Mile
5 000 Feet

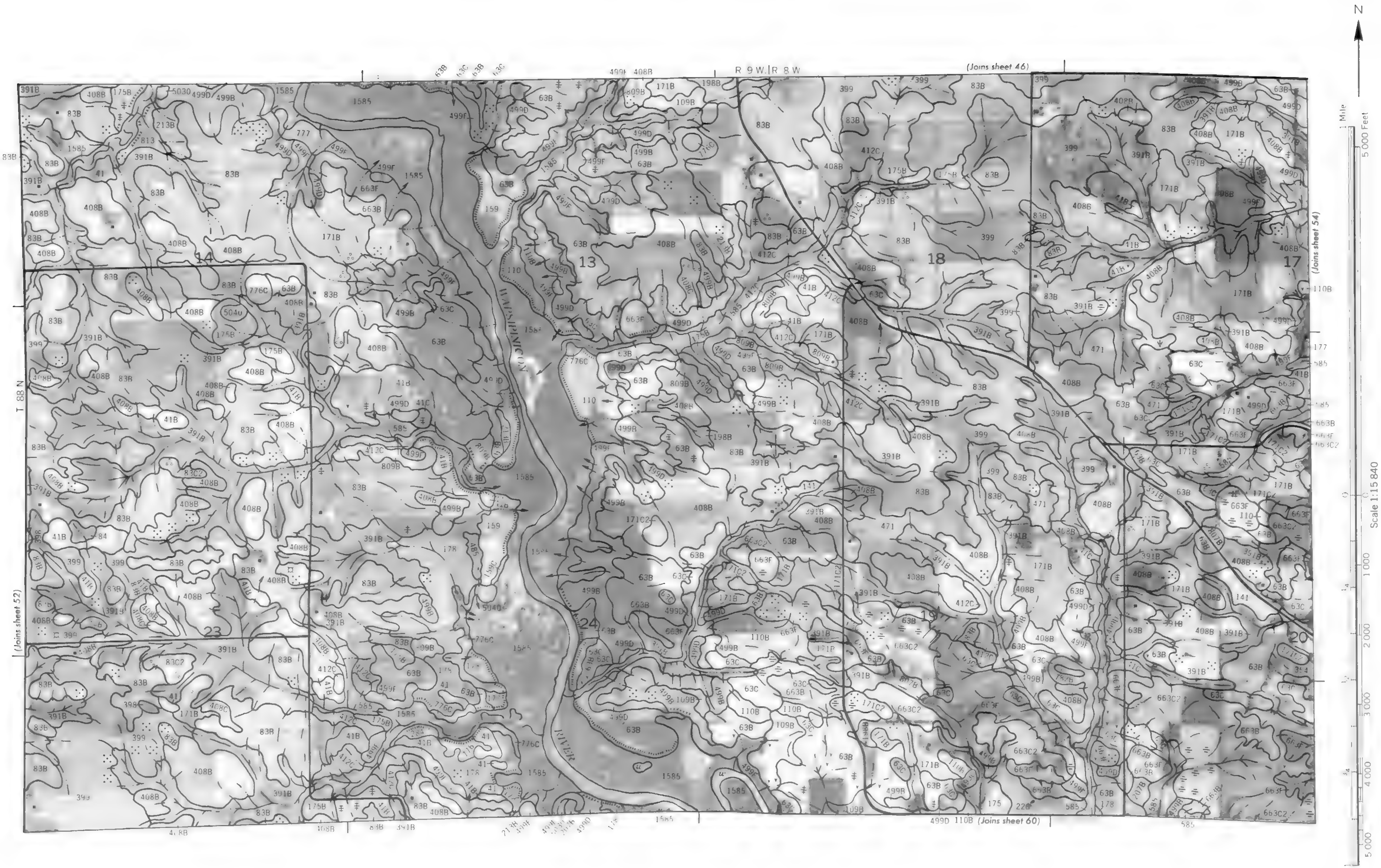

N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 43)
R 10 W
T 88 N
(Joins sheet 51)
(Joins sheet 57)
BLACK HAWK COUNTY
18
17
16
19
20
21
Spring Creek
East Branch

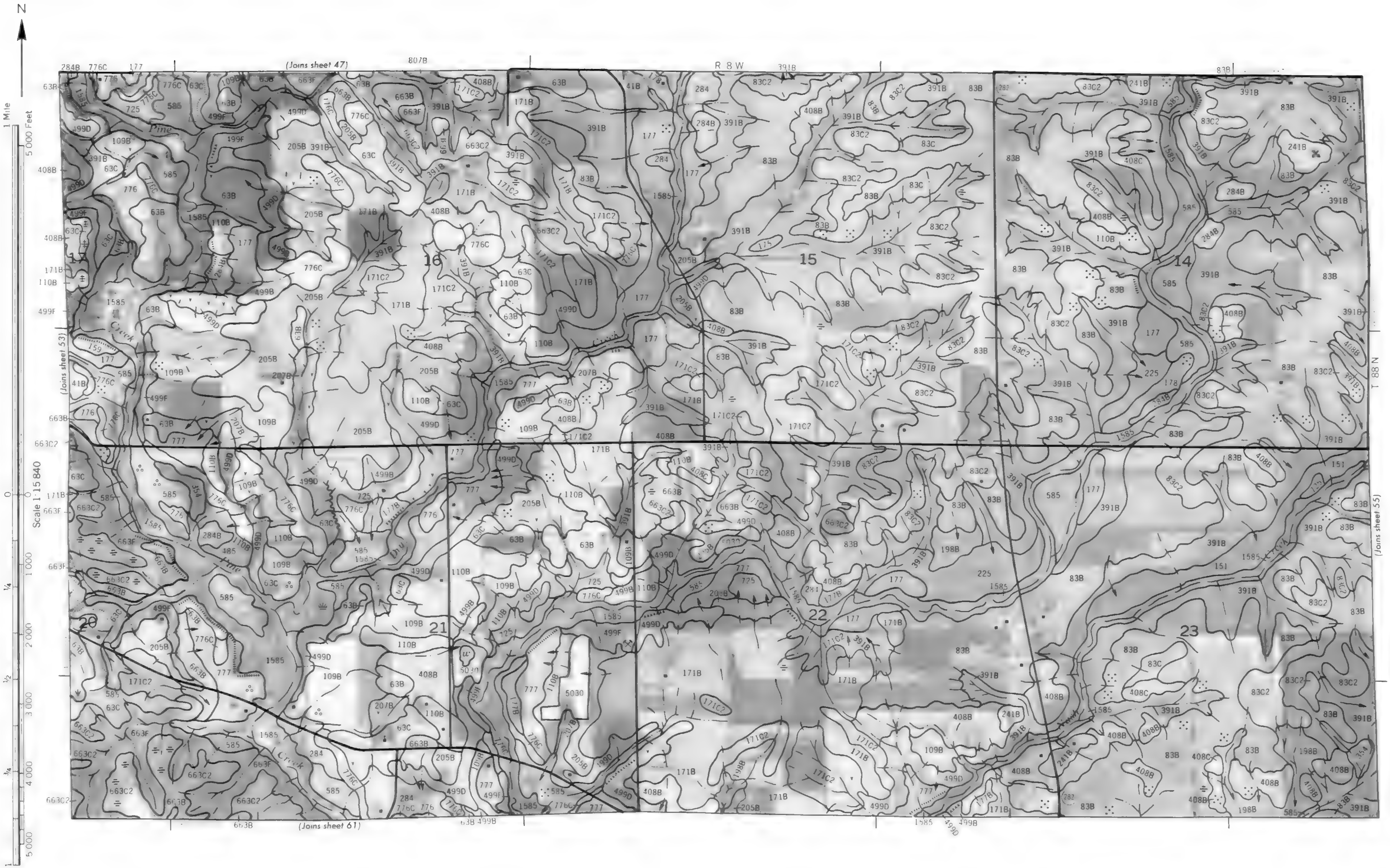

N
(Joins sheet 44)
R 10 W | R 9 W
(Joins sheet 52)
(Joins sheet 50)
(Joins sheet 58)
T 88 N
15
14
13
18
22
23
24
19
Lime Creek
1 Mile
5 000 Feet
Scale 1:15 840

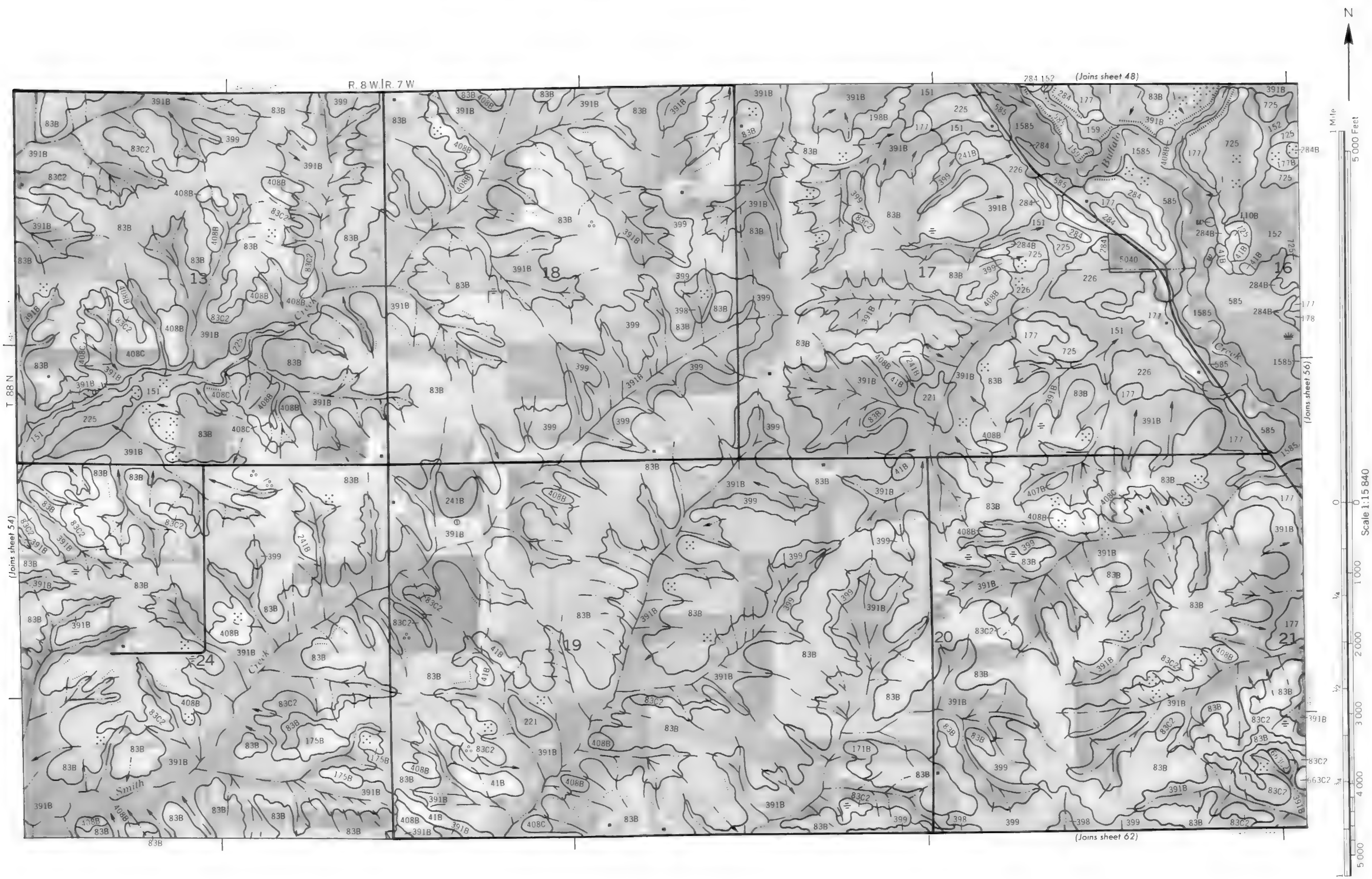
52

N

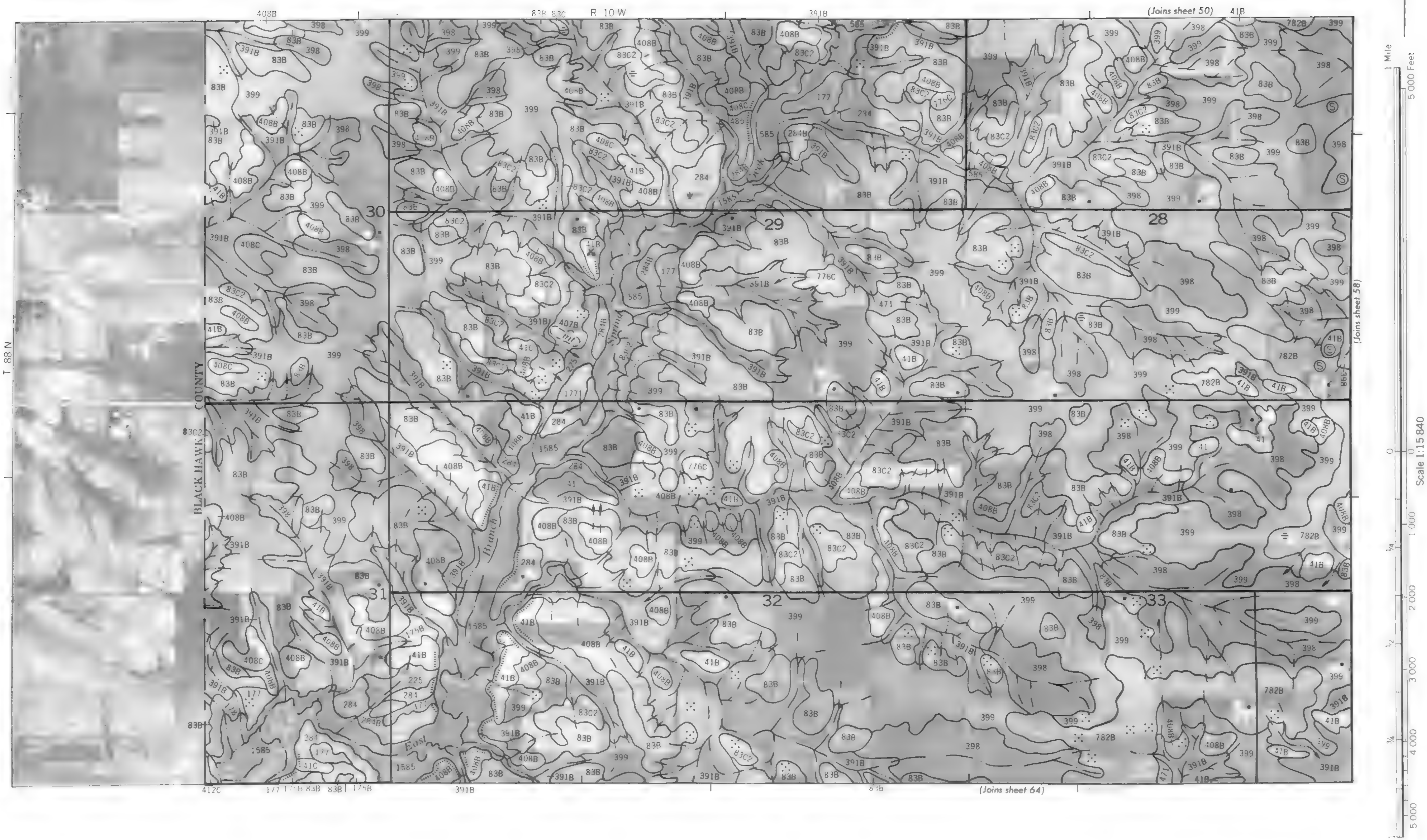

(Joins sheet 45)
(Joins sheet 51)
(Joins sheet 53)
(Joins sheet 59)
R. 9 W.
T. 88 N.
Scale 1:15 840
1 Mile
5 000 Feet
2 425 000 FEET
15
16
17
18
19
20
21
22
CHICAGO ROCK ISLAND AND PACIFIC
Bear Creek

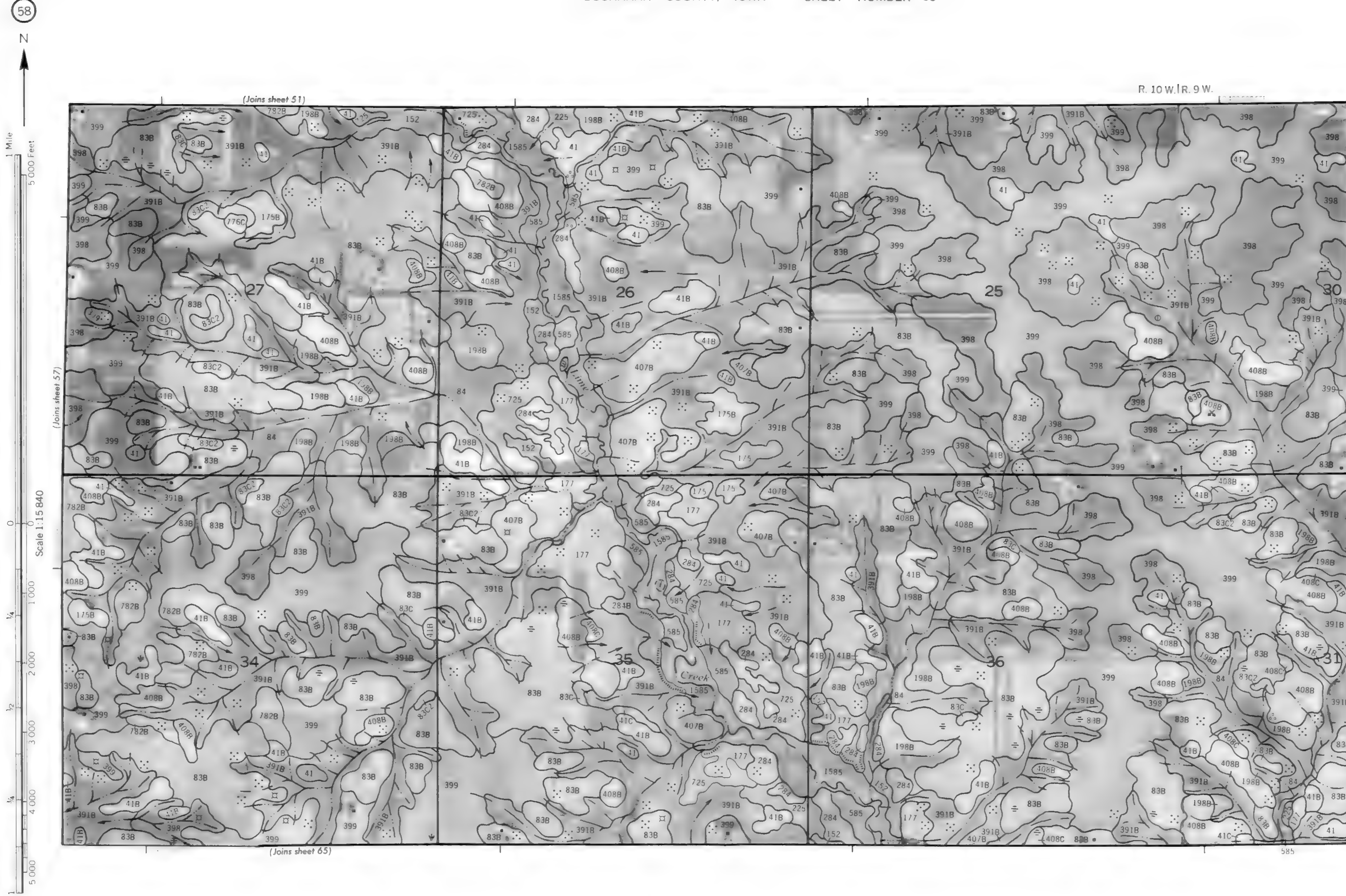

N
(Joins sheet 46)
R 9 W. R 8 W
T 88 N
(Joins sheet 52)
(Joins sheet 54)
(Joins sheet 60)
WAPSIPINICON
RIVER
13
14
17
18
19
20
23
24
1 Mile
5 000 Feet
Scale 1:15 840

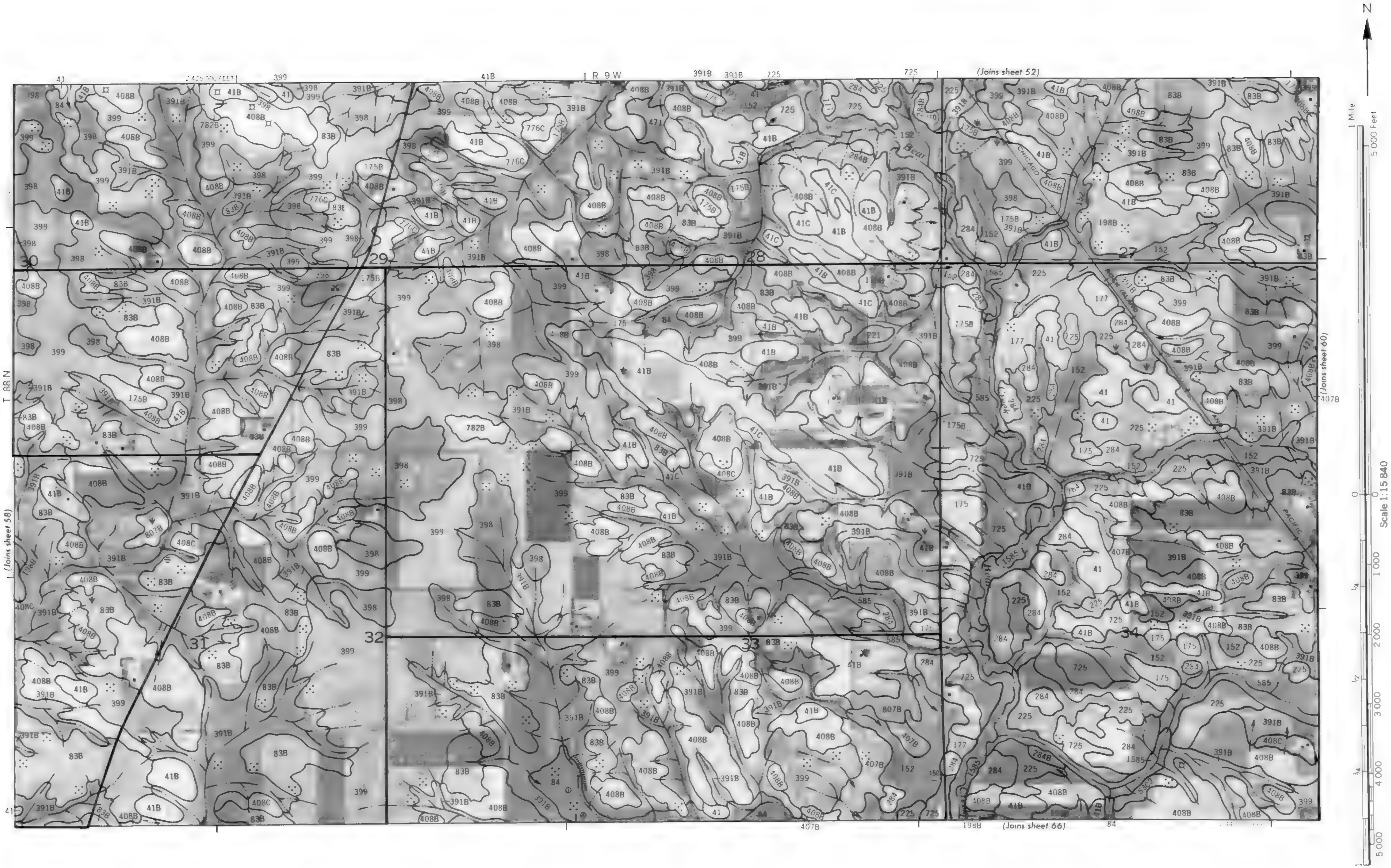

N
(Joins sheet 47)
R 8 W
(Joins sheet 53)
(Joins sheet 55)
T 88 N
(Joins sheet 61)
1 Mile
5 000 Feet
Scale 1:15 840
Pine Creek
17
16
15
14
20
21
22
23

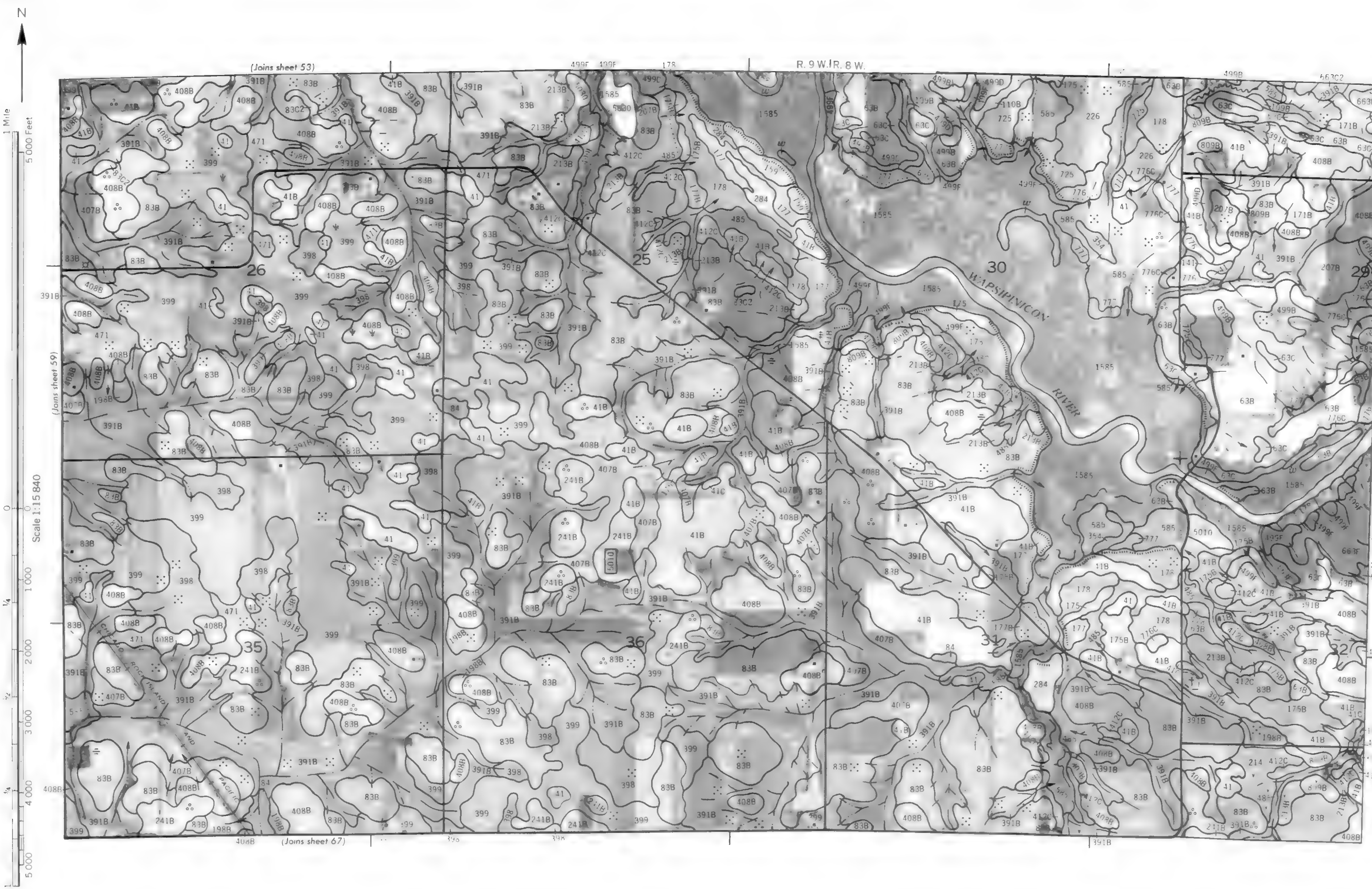

55
N
(Joins sheet 48)
(Joins sheet 56)
(Joins sheet 62)
(Joins sheet 54)
R. 8 W. | R. 7 W.
T. 88 N.
13
18
17
16
24
19
20
21
Creek
Smith
Buffalo
Creek
1 Mile
5 000 Feet
Scale 1:15 840
0
1 000
2 000
3 000
4 000
5 000
¼
½
¾


N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 49)
R 7 W
(Joins sheet 55)
(Joins sheet 63)
T 88 N
DELAWARE COUNTY
Buffalo
Creek
16
15
14
13
21
22
23
24

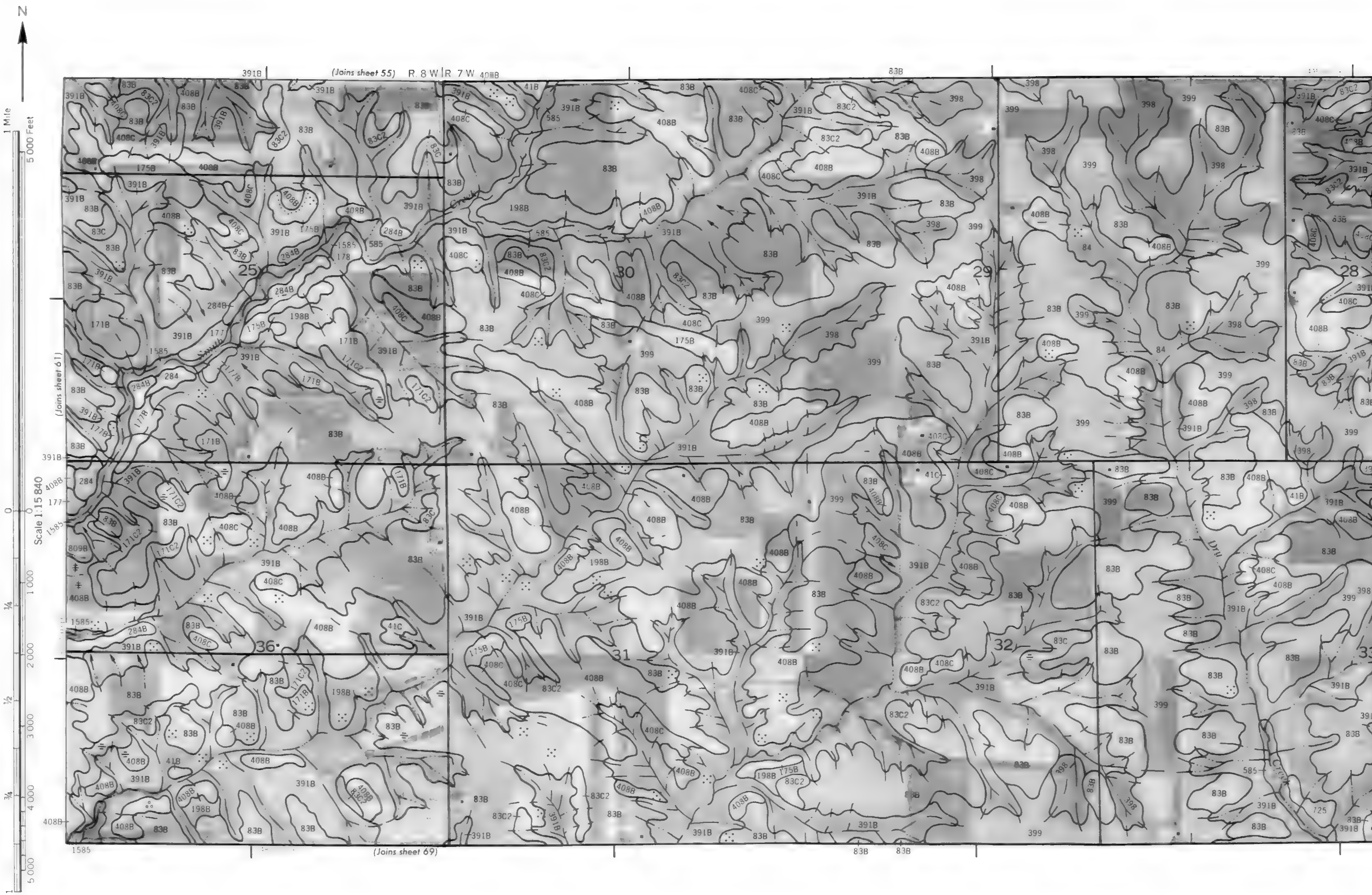

R 10 W
T 88 N
(Joins sheet 50)
(Joins sheet 58)
(Joins sheet 64)
BLACK HAWK COUNTY
30
29
28
31
32
33
57
N
1 Mile
5 000 Feet
Scale 1:15 840

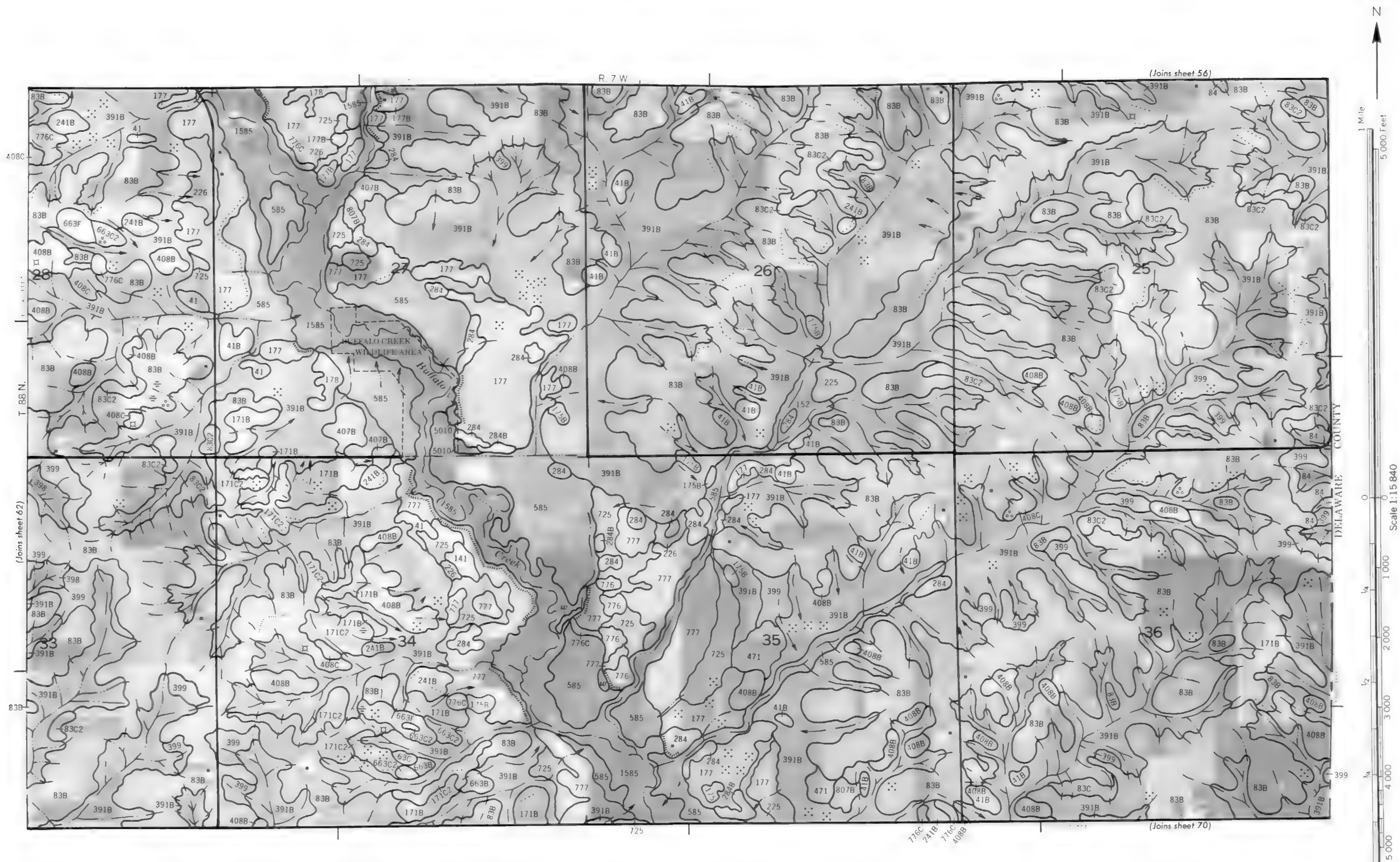

58
N
(Joins sheet 51)
(Joins sheet 57)
(Joins sheet 59)
(Joins sheet 65)
R. 10 W. | R. 9 W.
T. 88 N.
27
26
25
30
34
35
36
31
Lime
Creek
1 Mile
5 000 Feet
Scale 1:15 840

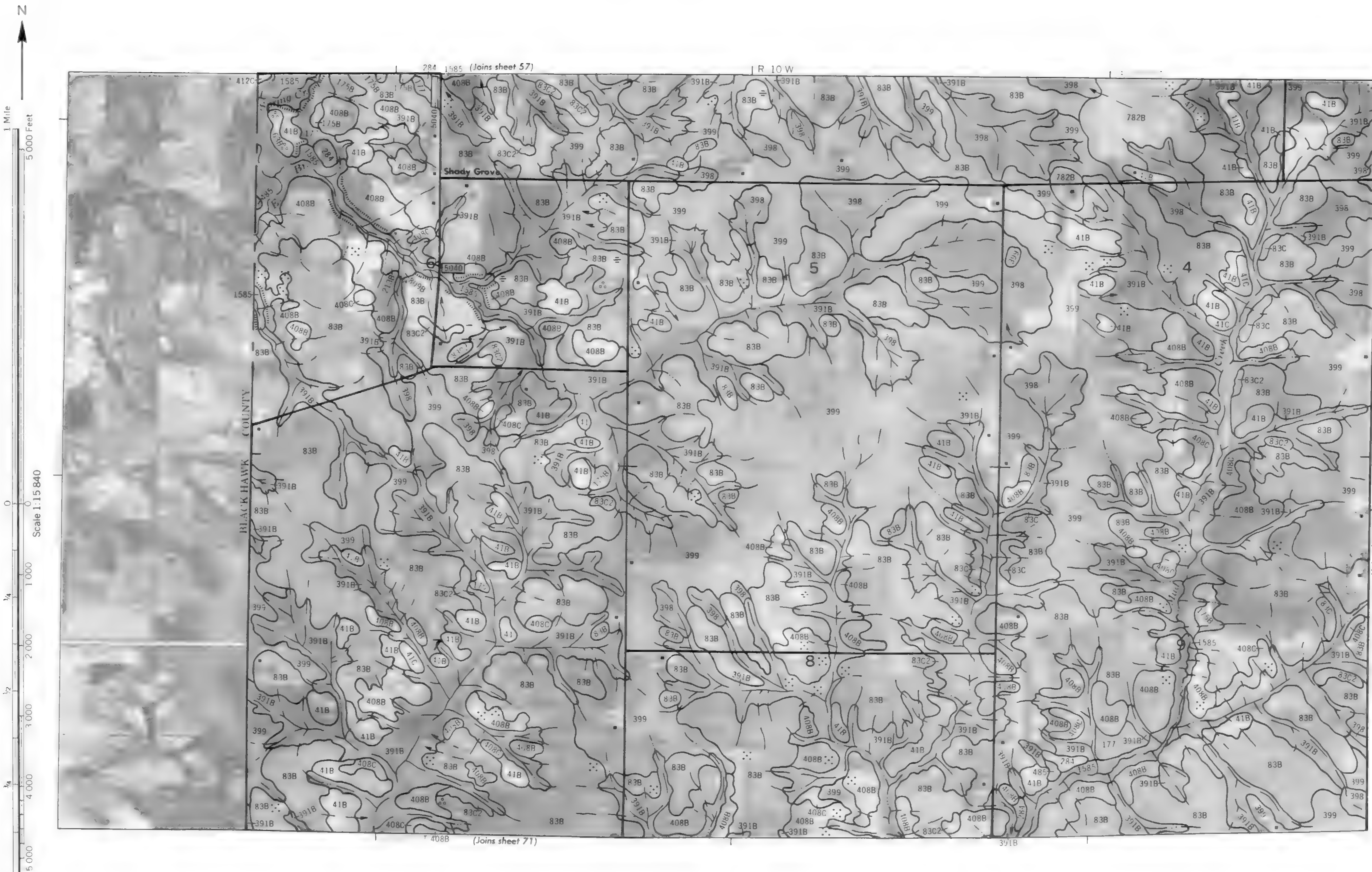

N
(Joins sheet 52)
R. 9 W.
T. 88 N.
(Joins sheet 58)
(Joins sheet 60)
(Joins sheet 66)
1 Mile
5 000 Feet
Scale 1:15 840
CHICAGO
PACIFIC
Bear
Creek
29
28
27
30
31
32
33
34

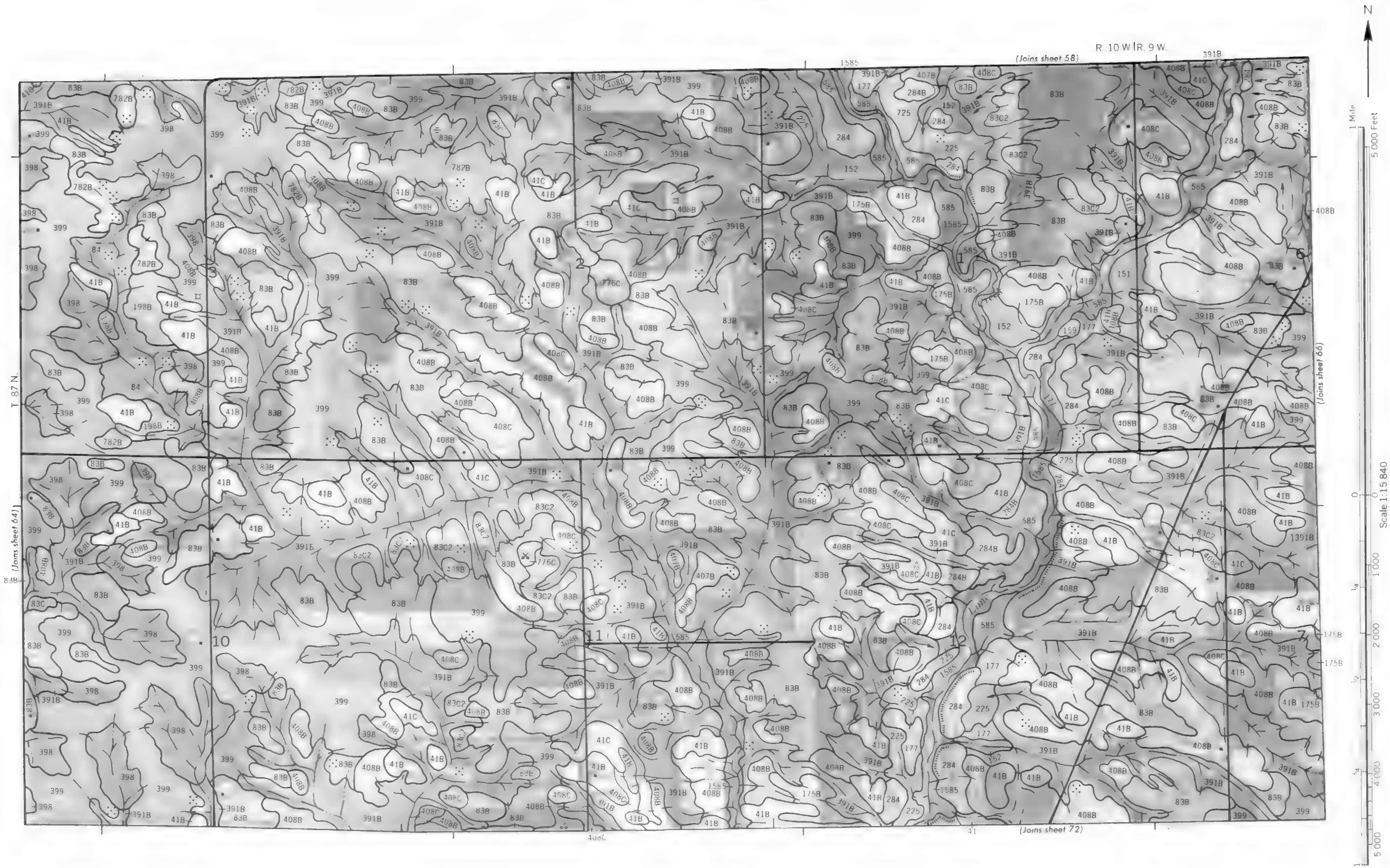

N
(Joins sheet 53)
R. 9 W. | R. 8 W.
(Joins sheet 59)
(Joins sheet 61)
(Joins sheet 67)
T. 88 N.
WAPSIPINICON
RIVER
26
25
30
29
35
36
31
32
CHICAGO ROCK ISLAND AND PACIFIC
1 Mile
5 000 Feet
Scale 1:15 840


61
N
R 8 W
T 88 N
(Joins sheet 54)
(Joins sheet 62)
(Joins sheet 68)
(Joins sheet 60)
WAPSIPINICON RIVER
Pine Creek
Nash Creek
Quasqueton
28
29
26
27
32
33
34
35
Scale 1:15 840
1 Mile
5 000 Feet
1000
2000
3000
4000
5000

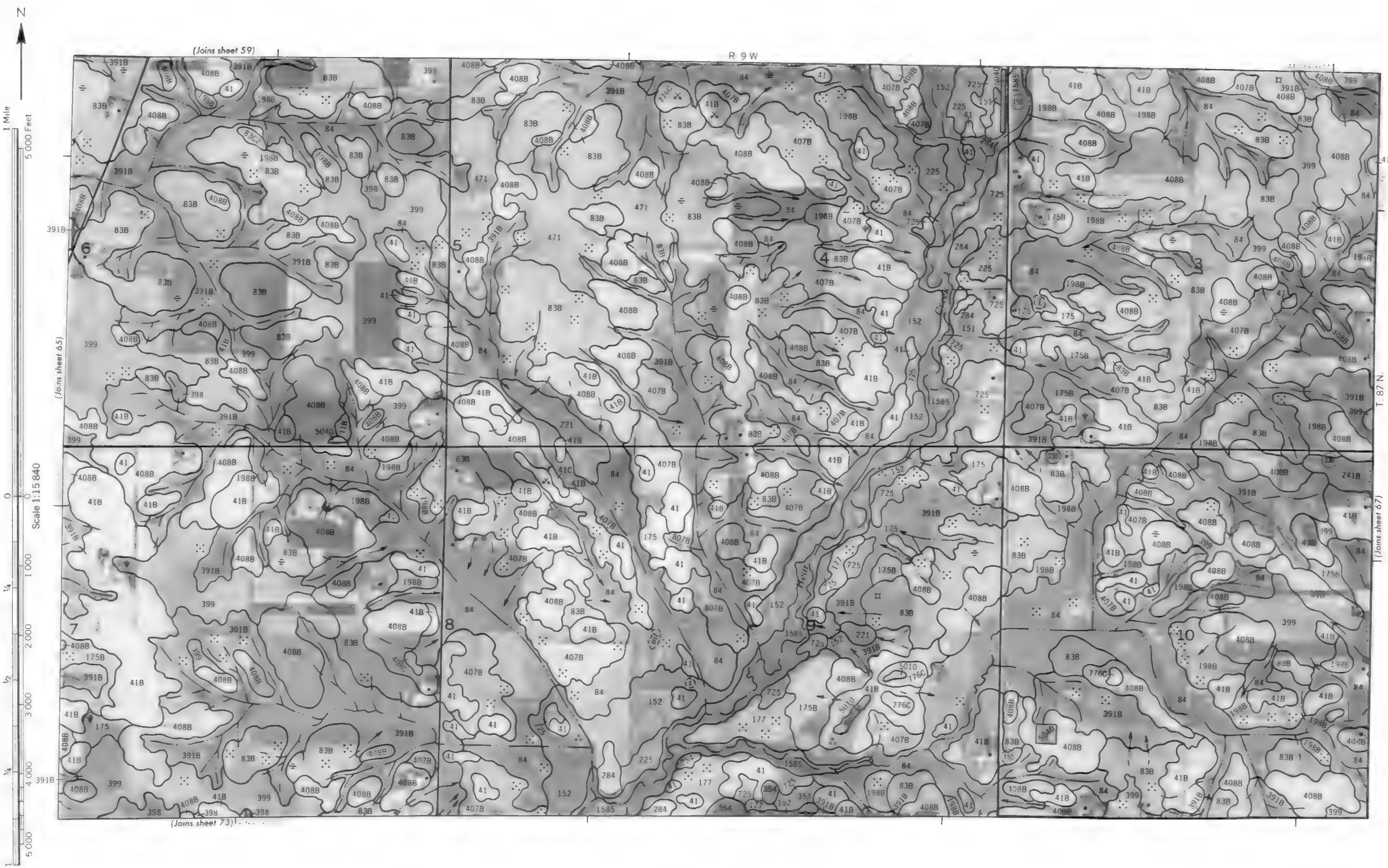

N
(Joins sheet 55)
R. 8 W. | R. 7 W.
(Joins sheet 61)
(Joins sheet 63)
(Joins sheet 69)
T. 88 N.
Scale 1:15 840
1 Mile
5 000 Feet
25
30
29
28
36
31
32
33

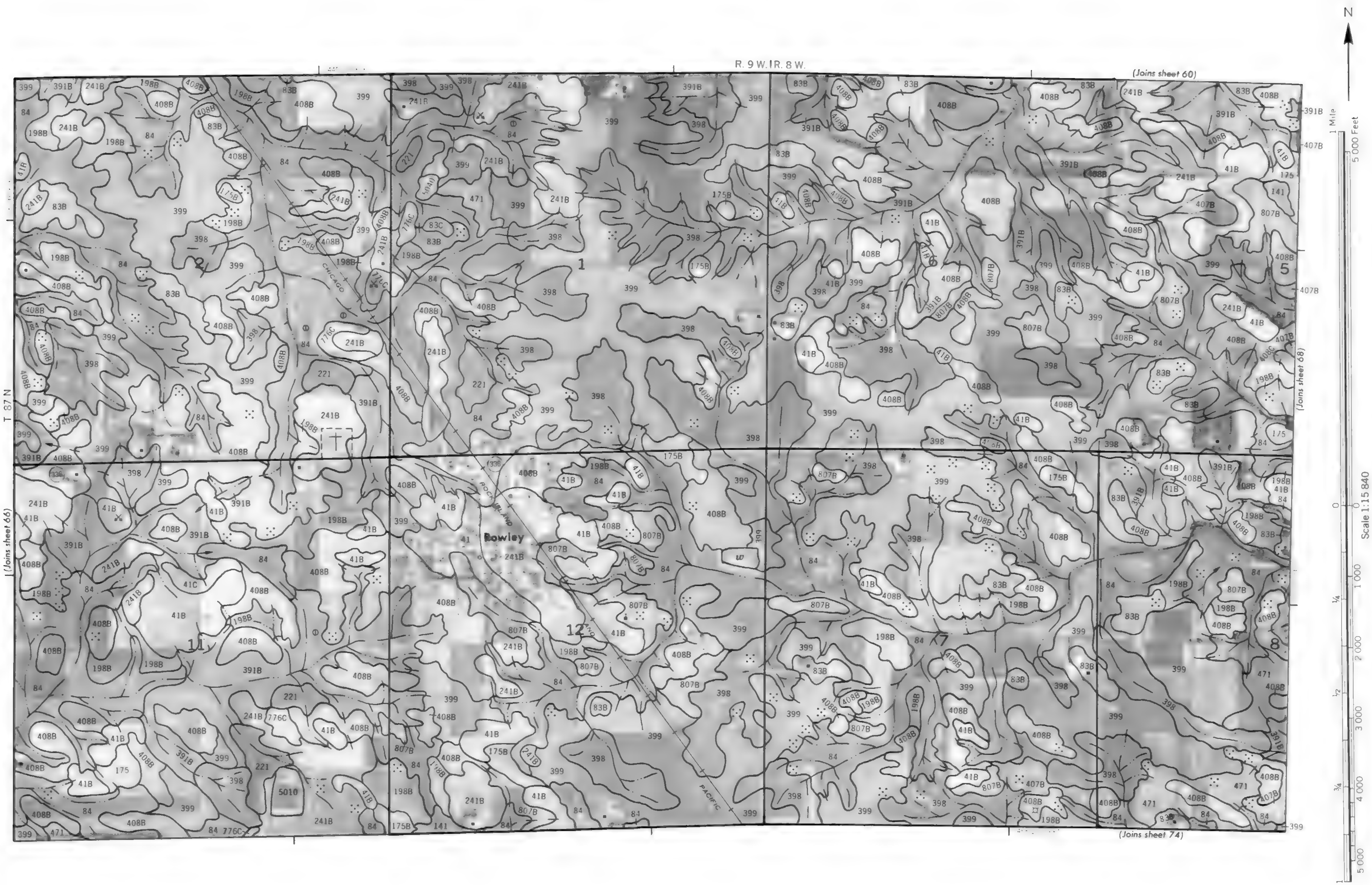

N
(Joins sheet 56)
R. 7 W.
T. 88 N.
(Joins sheet 62)
(Joins sheet 70)
DELAWARE COUNTY
BUFFALO CREEK WILDLIFE AREA
Buffalo Creek
28
27
26
25
33
34
35
36
1 Mile
5 000 Feet
Scale 1:15 840
0
1000
2000
3000
4000
5000
1/4
1/2
3/4


N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 57)
R. 10 W.
Shady Grove
BLACK HAWK COUNTY
T. 87 N.
(Joins sheet 65)
(Joins sheet 71)
5
4
8
9
6

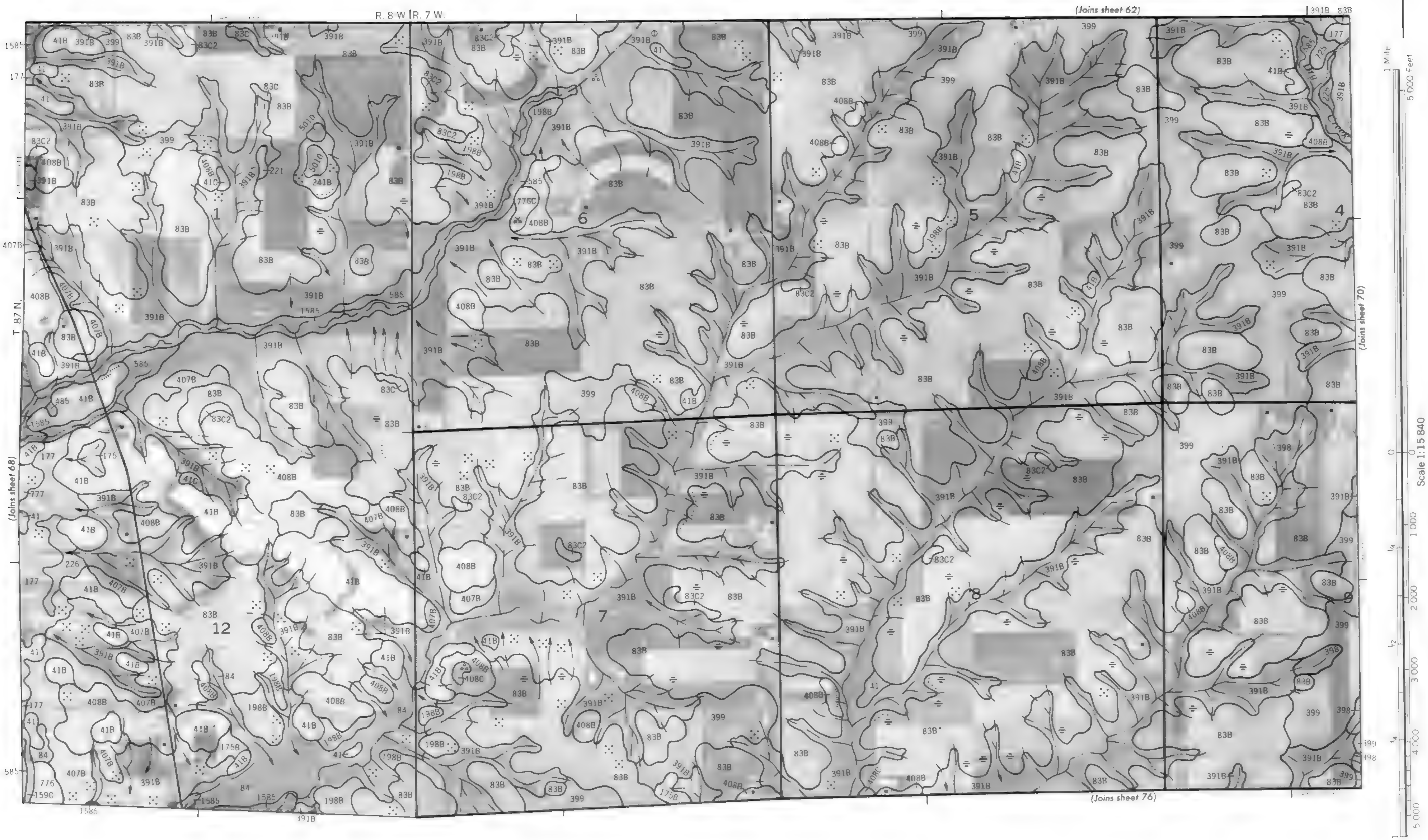

N
R. 10 W. | R. 9 W.
(Joins sheet 58)
(Joins sheet 66)
(Joins sheet 72)
(Joins sheet 64)
T. 87 N.
1 Mile
5 000 Feet
Scale 1:15 840

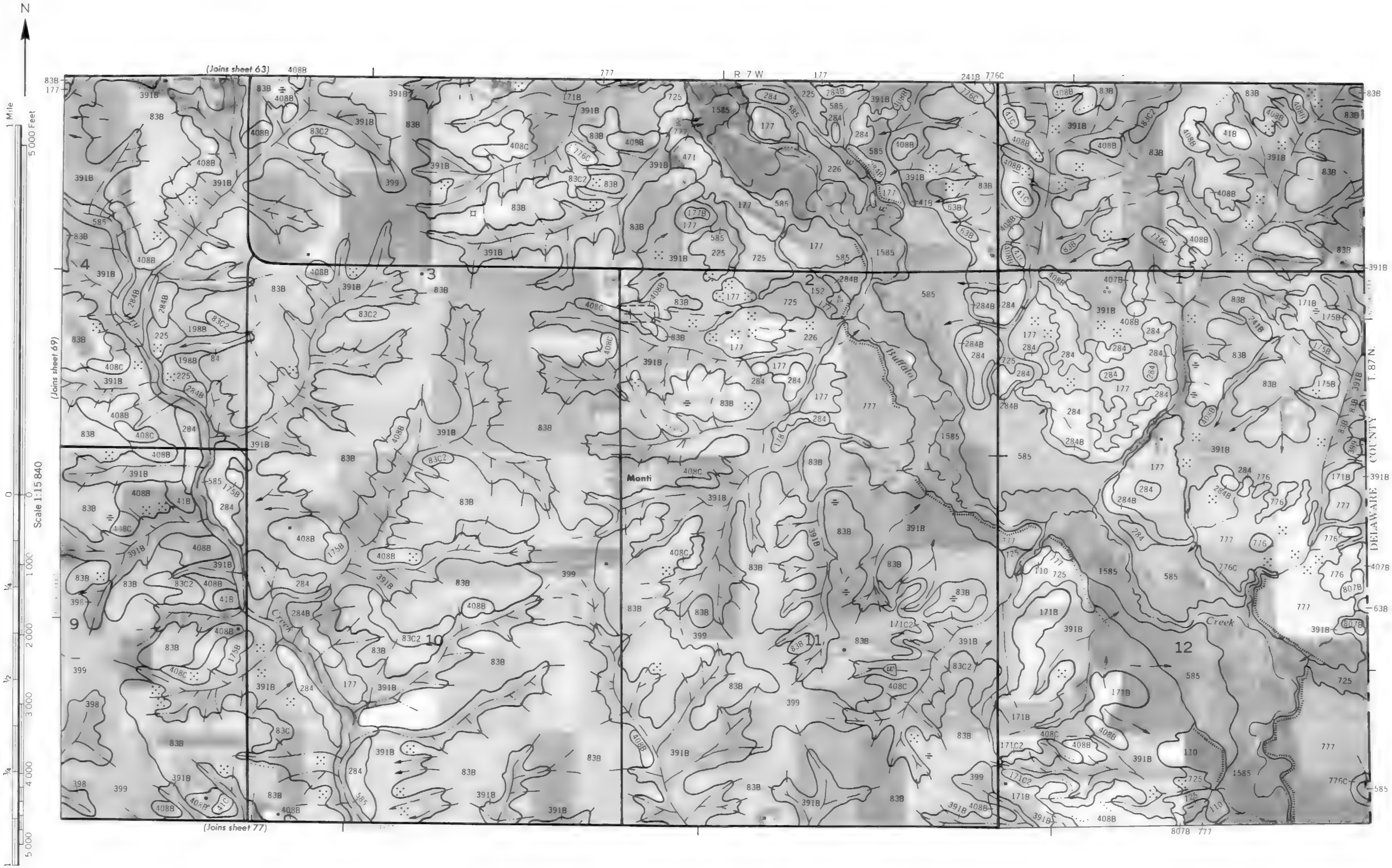
BUCHANAN COUNTY, IOWA — SHEET NUMBER 66

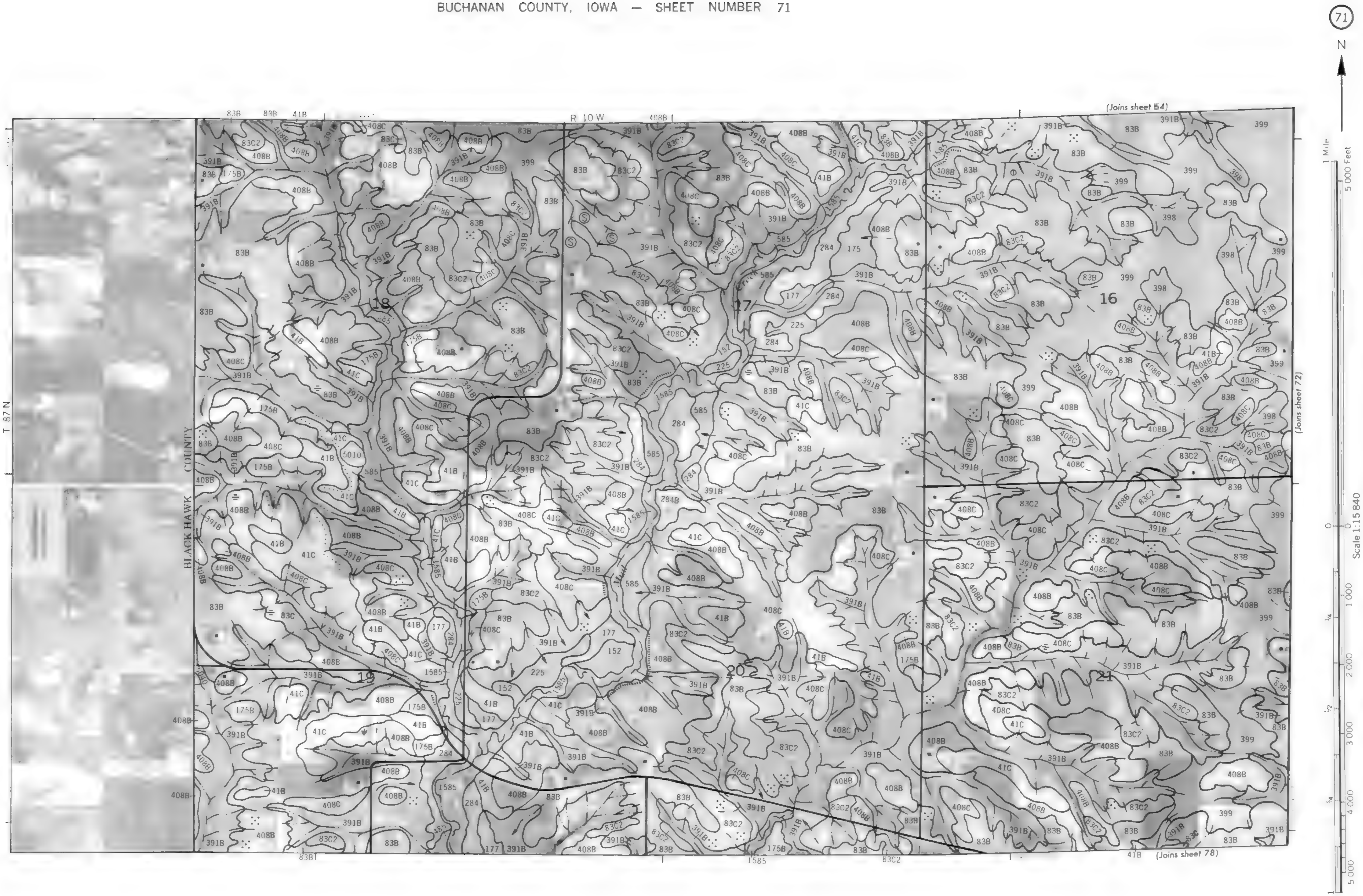



67
N
R. 9 W. | R. 8 W.
(Joins sheet 60)
(Joins sheet 68)
(Joins sheet 74)
(Joins sheet 66)
T 87 N
Rowley
CHICAGO
ROCK ISLAND AND
PACIFIC
1
2
5
6
7
8
11
12
Scale 1:15 840
1 Mile
5 000 Feet

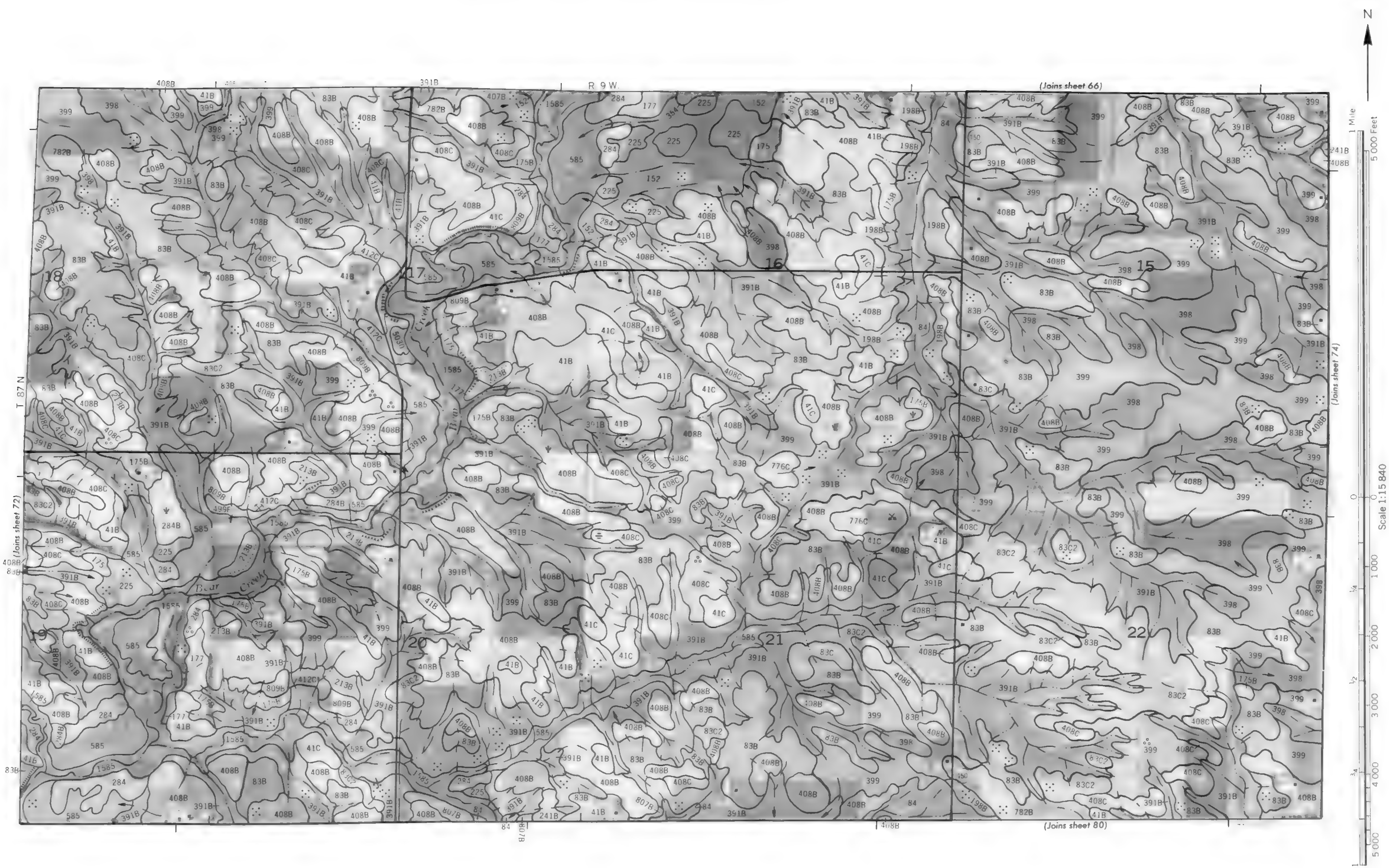

N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 61)
R 8 W
T. 87 N.
(Joins sheet 67)
(Joins sheet 69)
(Joins sheet 75)
WAPSIPINICON
RIVER
3
4
5
8
9
10
11

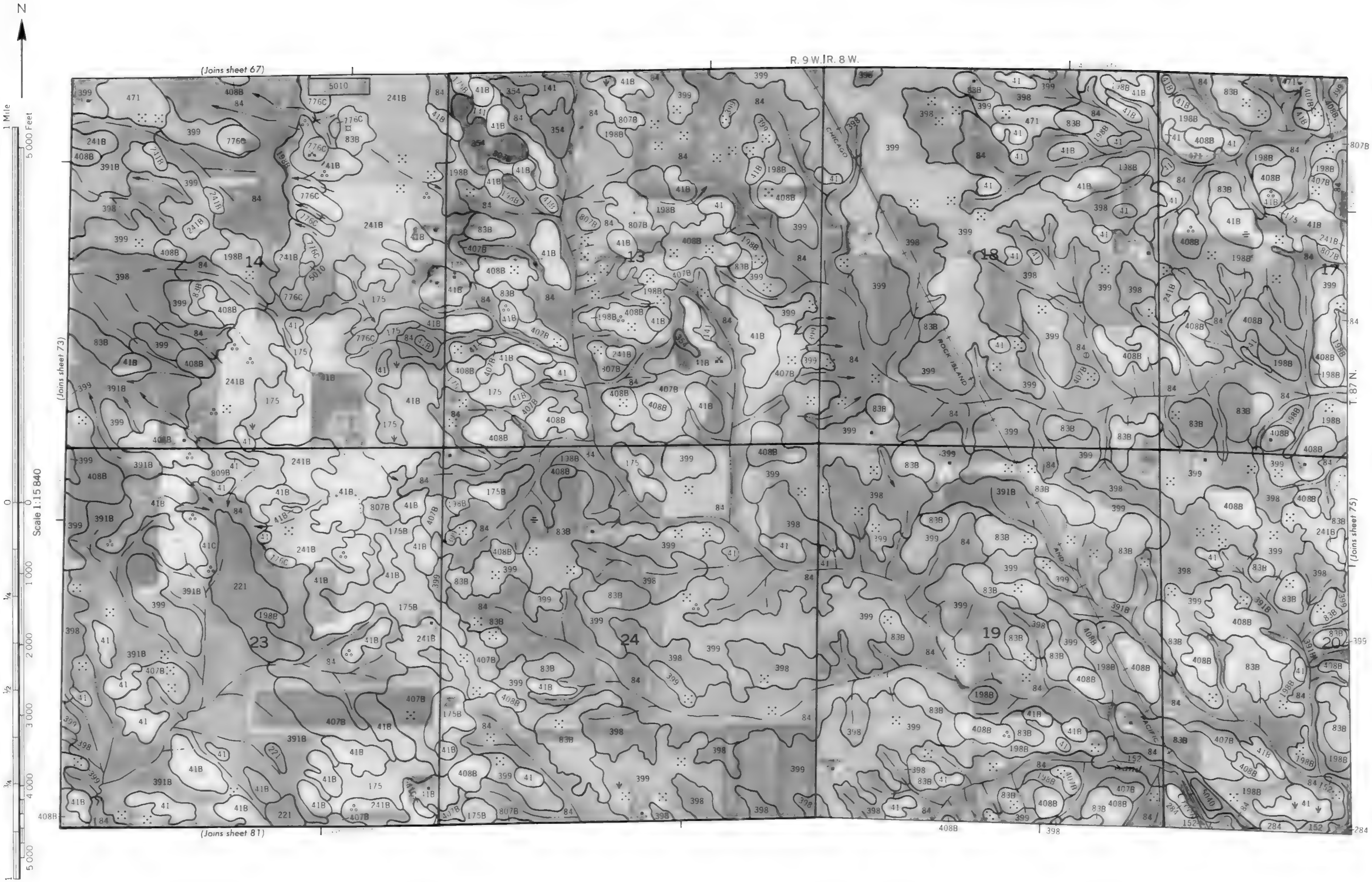

N
R. 8 W.
R. 7 W.
T. 87 N.
(Joins sheet 62)
(Joins sheet 70)
(Joins sheet 76)
(Joins sheet 68)
1
6
5
4
12
7
8
9
1 Mile
5 000 Feet
Scale 1:15 840

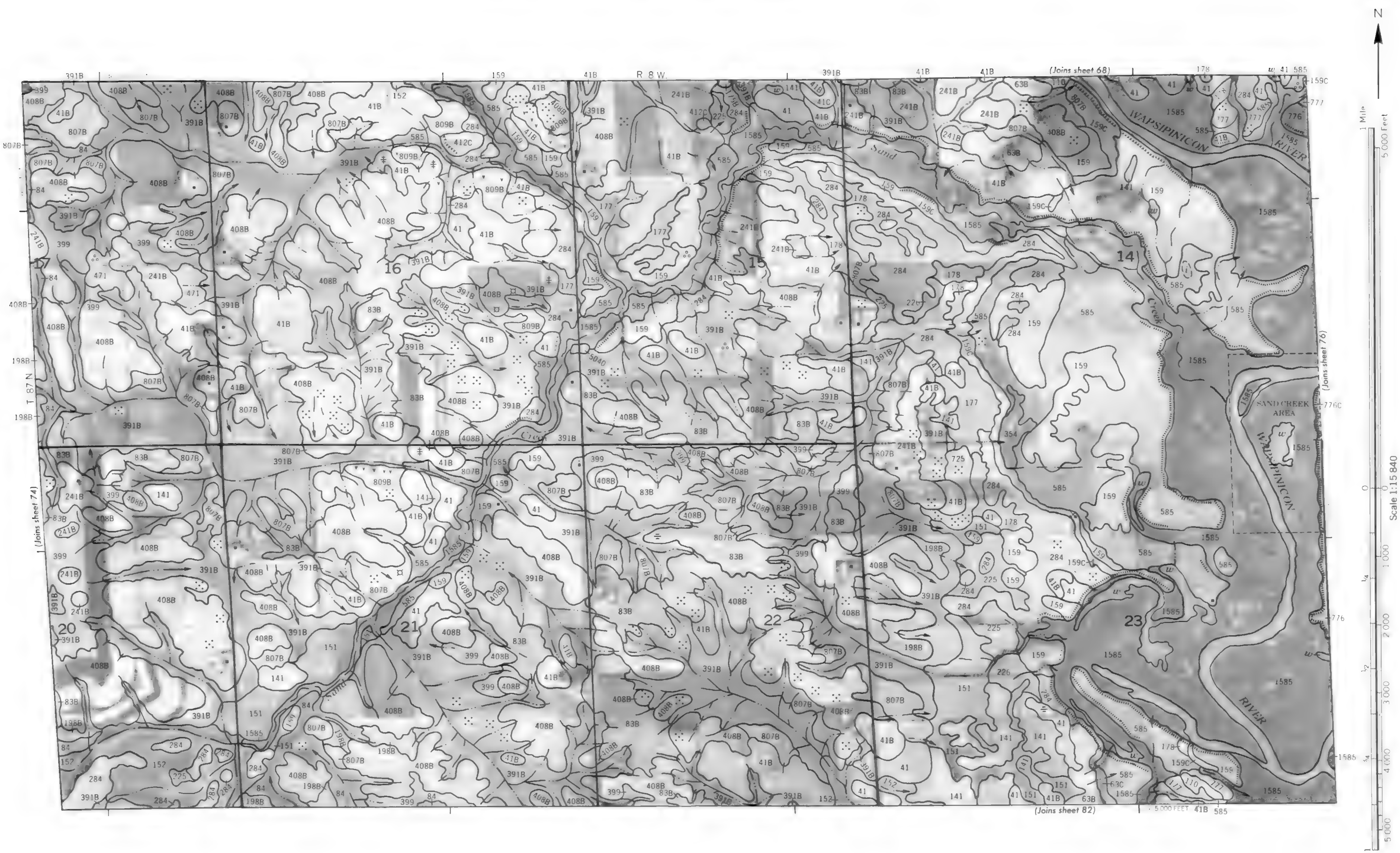

N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 63)
(Joins sheet 69)
(Joins sheet 77)
R 7 W
T. 87 N.
DELAWARE COUNTY
Monti
Buffalo
Creek

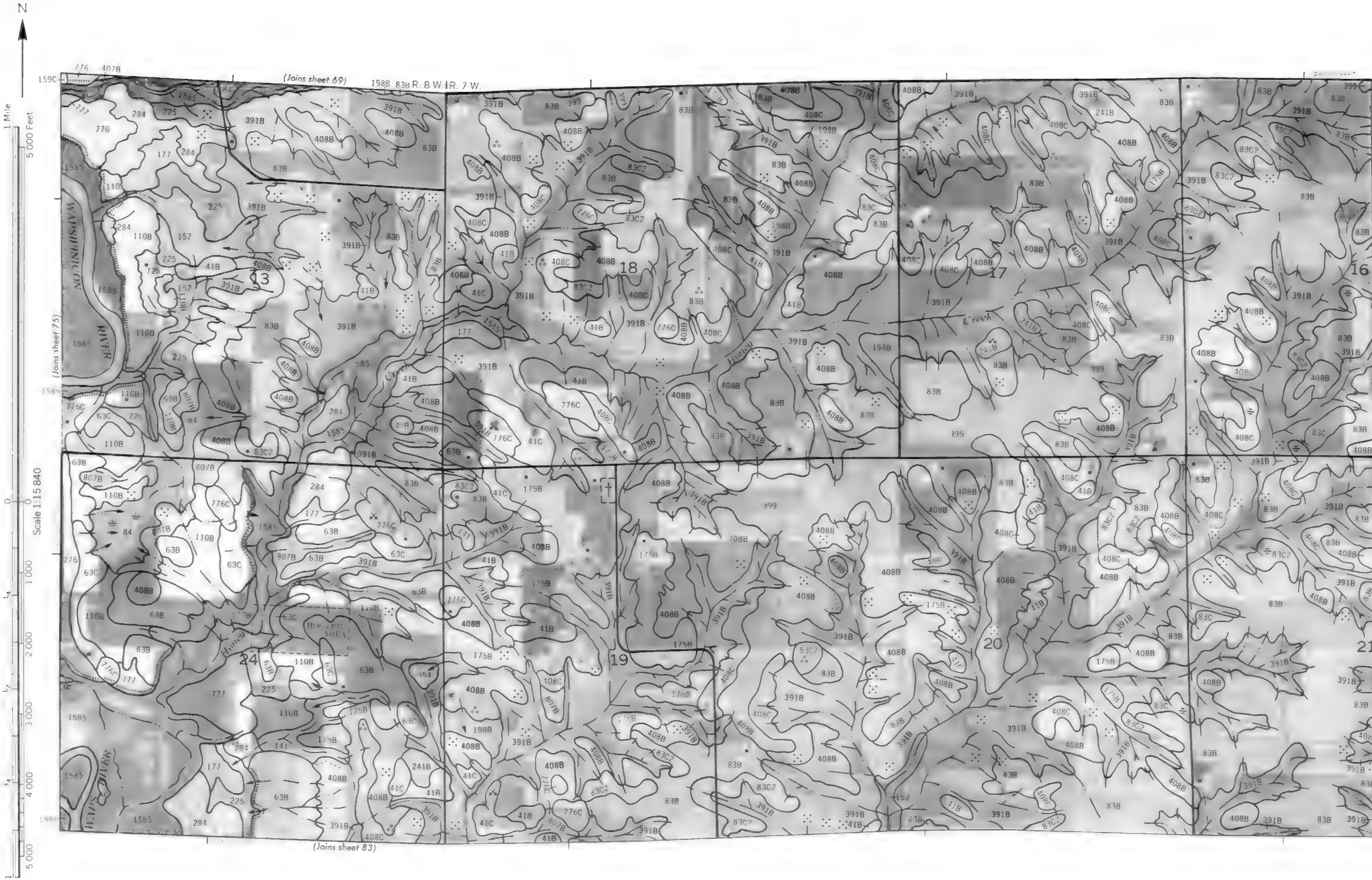

71
N
(Joins sheet 54)
(Joins sheet 72)
(Joins sheet 78)
R 10 W
T 87 N
BLACK HAWK COUNTY
16
17
18
19
20
21
1 Mile
5 000 Feet
Scale 1:15 840


N
Scale 1:15 840
1 Mile
5 000 Feet
(Joins sheet 65)
(Joins sheet 79)
(Joins sheet 71)
(Joins sheet 73)
R. 10 W. | R. 9 W.
T 87 N
15
14
13
18
22
23
24
19
Lime Creek
LIME CREEK AREA

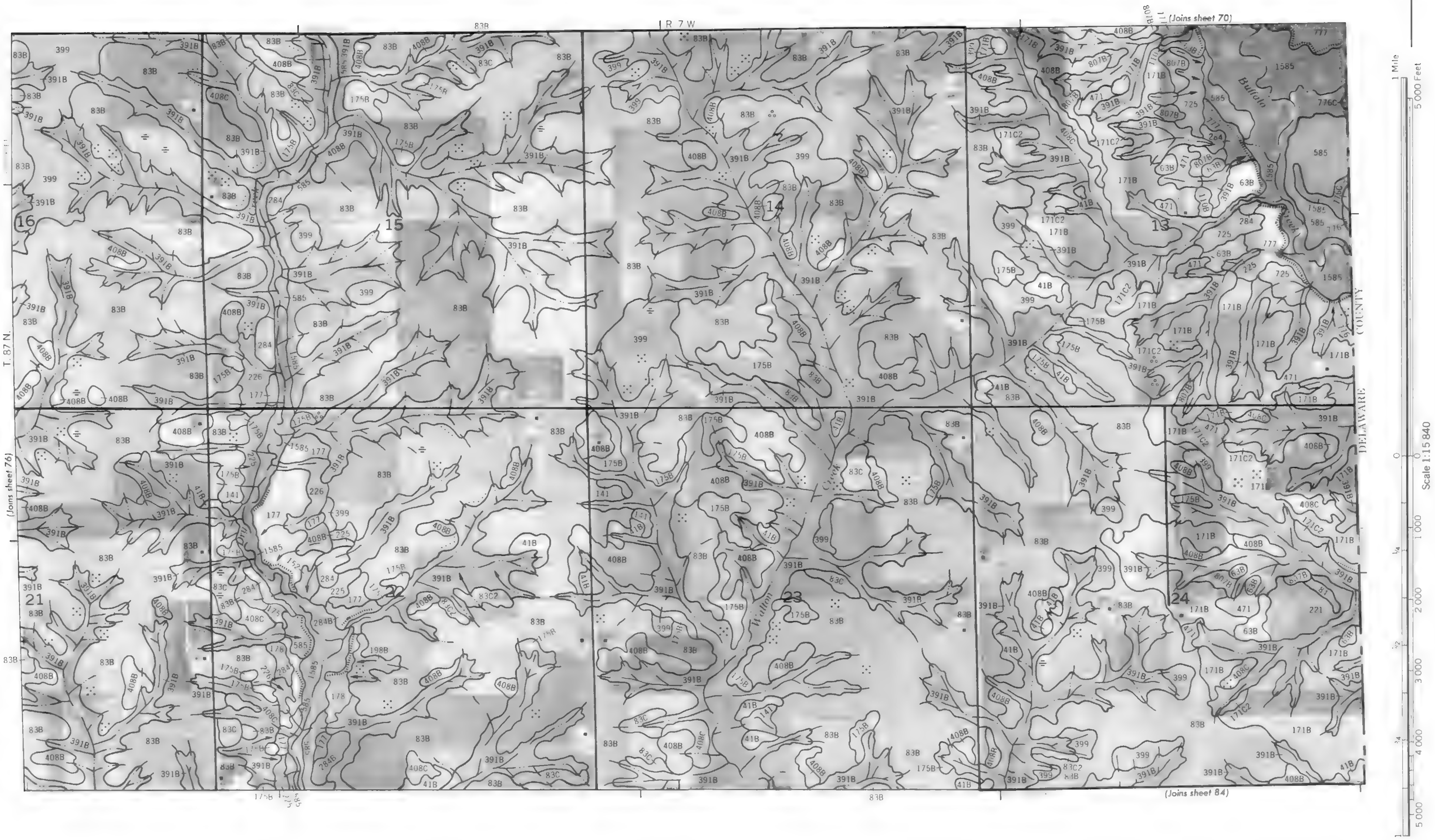

N
(Joins sheet 66)
R. 9 W.
T. 87 N.
(Joins sheet 72)
(Joins sheet 74)
(Joins sheet 80)
Bear Creek
18
17
16
15
19
20
21
22
1 Mile
5 000 Feet
Scale 1:15 840

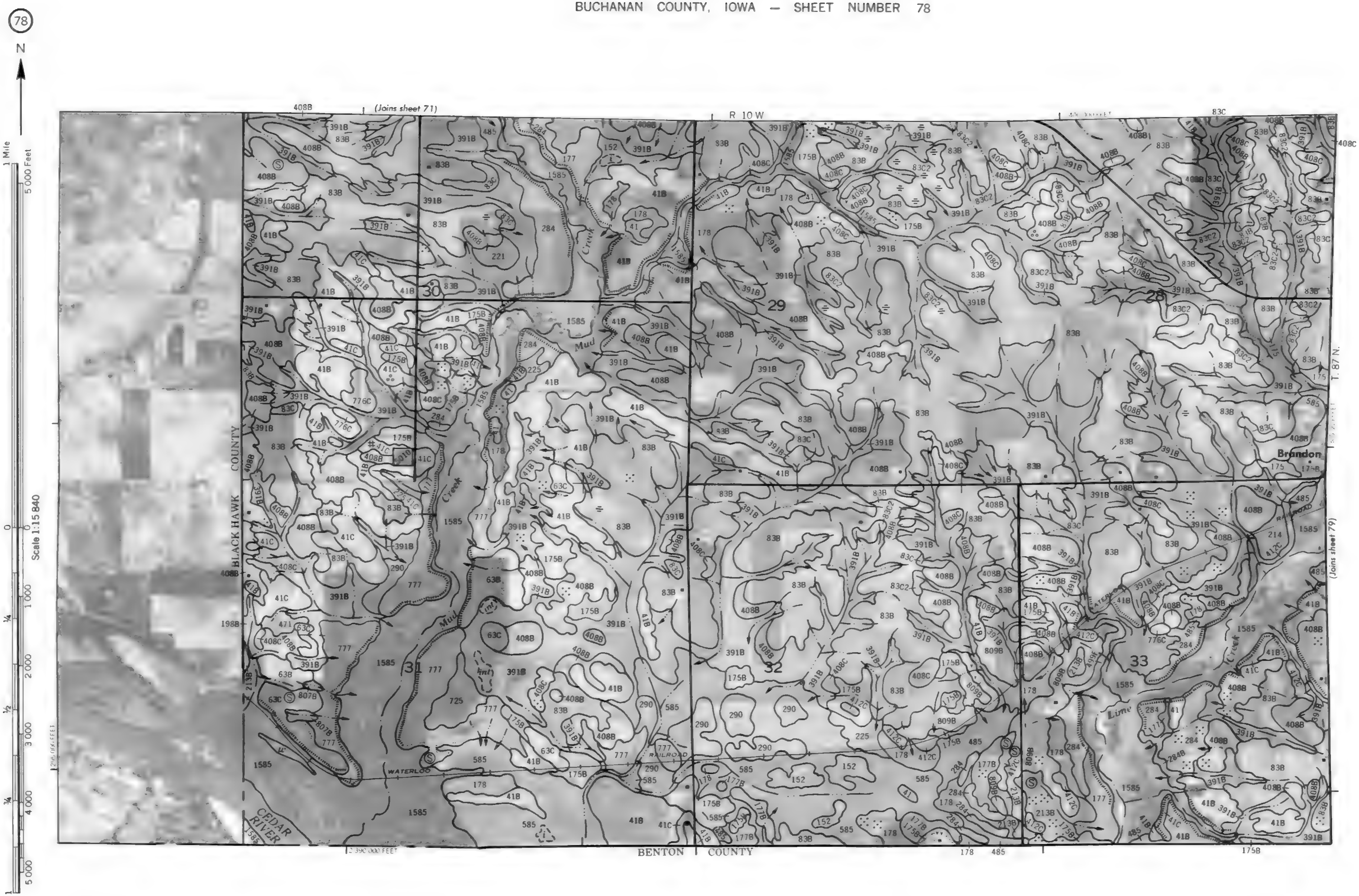

N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 67)
(Joins sheet 73)
(Joins sheet 75)
(Joins sheet 81)
R. 9 W. | R. 8 W.
T. 87 N.
14
13
18
17
23
24
19
20
CHICAGO
ROCK ISLAND
AND
PACIFIC

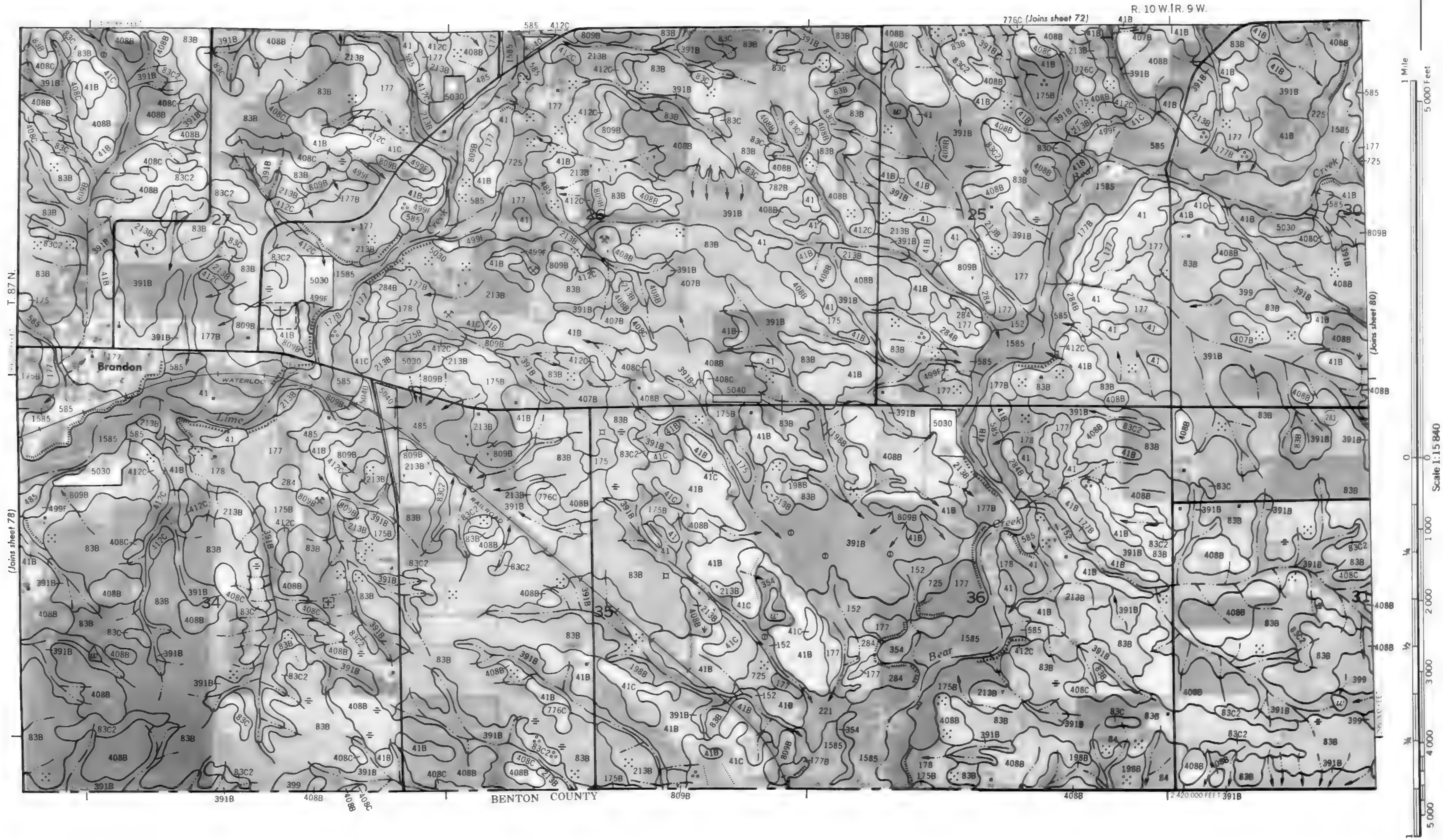

75
N
R 8 W.
T 87 N
(Joins sheet 68)
(Joins sheet 74)
(Joins sheet 76)
(Joins sheet 82)
WAPSIPINICON RIVER
Sand Creek
SAND CREEK AREA
WAPSIPINICON RIVER
1 Mile
5 000 Feet
Scale 1:15 840
0
1 000
2 000
3 000
4 000
5 000
5 000 FEET
14
15
16
17
20
21
22
23

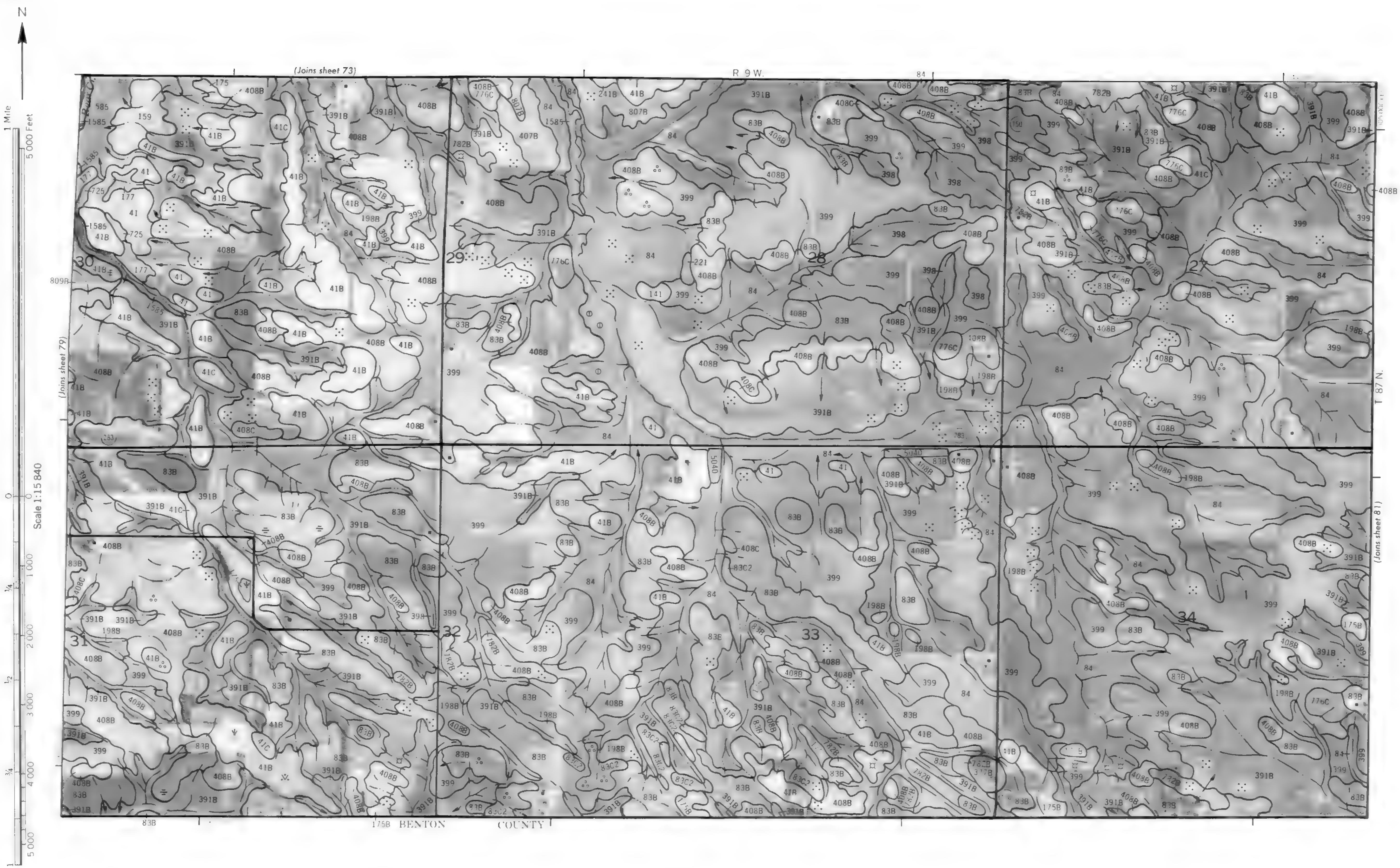

N
1 Mile
5 000 Feet
0
Scale 1:15 840
1 000
2 000
3 000
4 000
5 000
(Joins sheet 69)
R. 8 W. | R. 7 W.
(Joins sheet 75)
(Joins sheet 77)
(Joins sheet 83)
T. 87 N.
WAPSIPINICON RIVER
Honey Creek
Creek
13
18
17
16
24
19
20
21

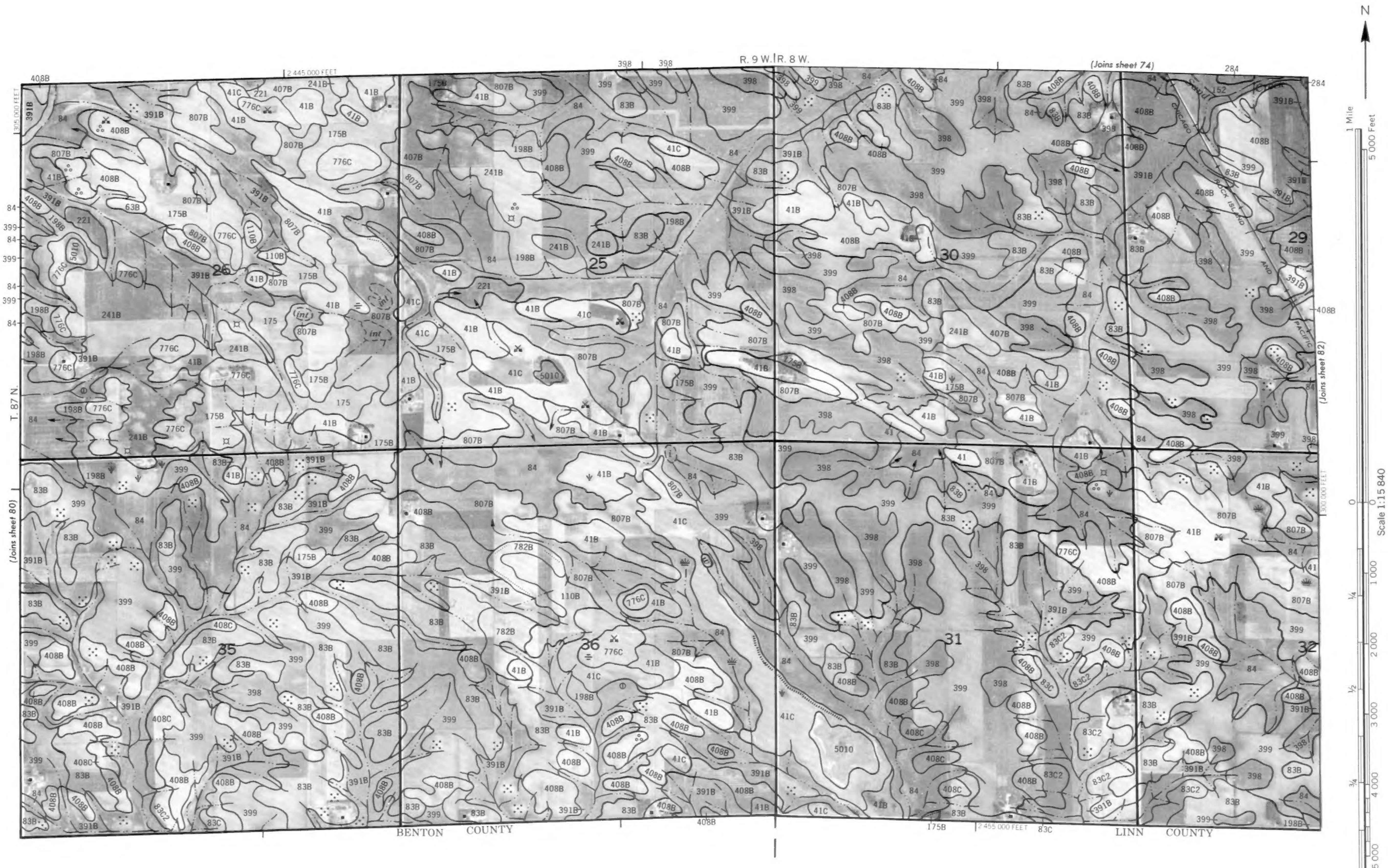
N

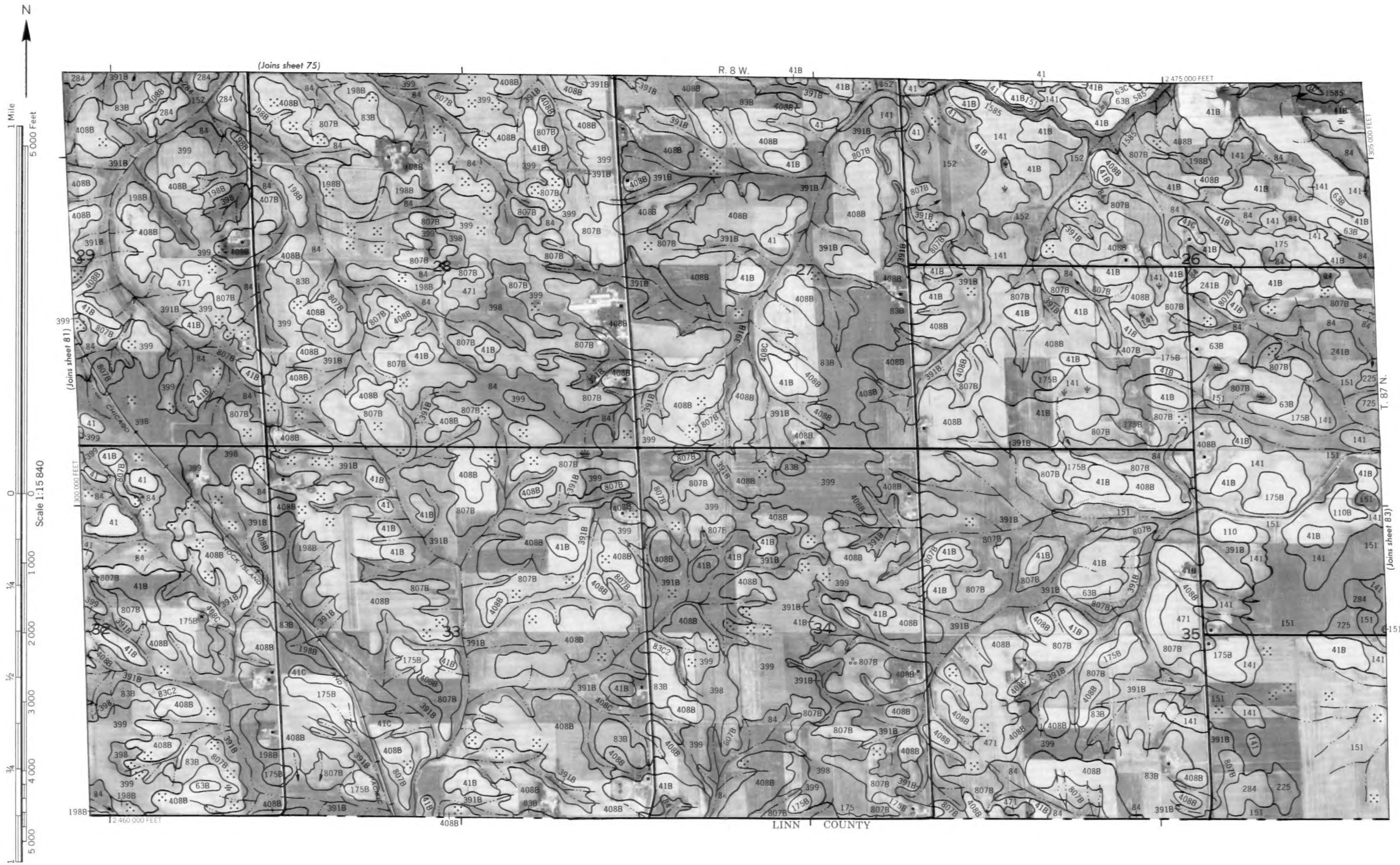

(Joins sheet 70)
R. 7 W.
T. 87 N.
(Joins sheet 76)
(Joins sheet 84)
DELAWARE COUNTY
Buffalo Creek
Walton Creek
Dry Creek
16
15
14
13
21
22
23
24
1 Mile
5 000 Feet
Scale 1:15 840
0
1 000
2 000
3 000
4 000
5 000

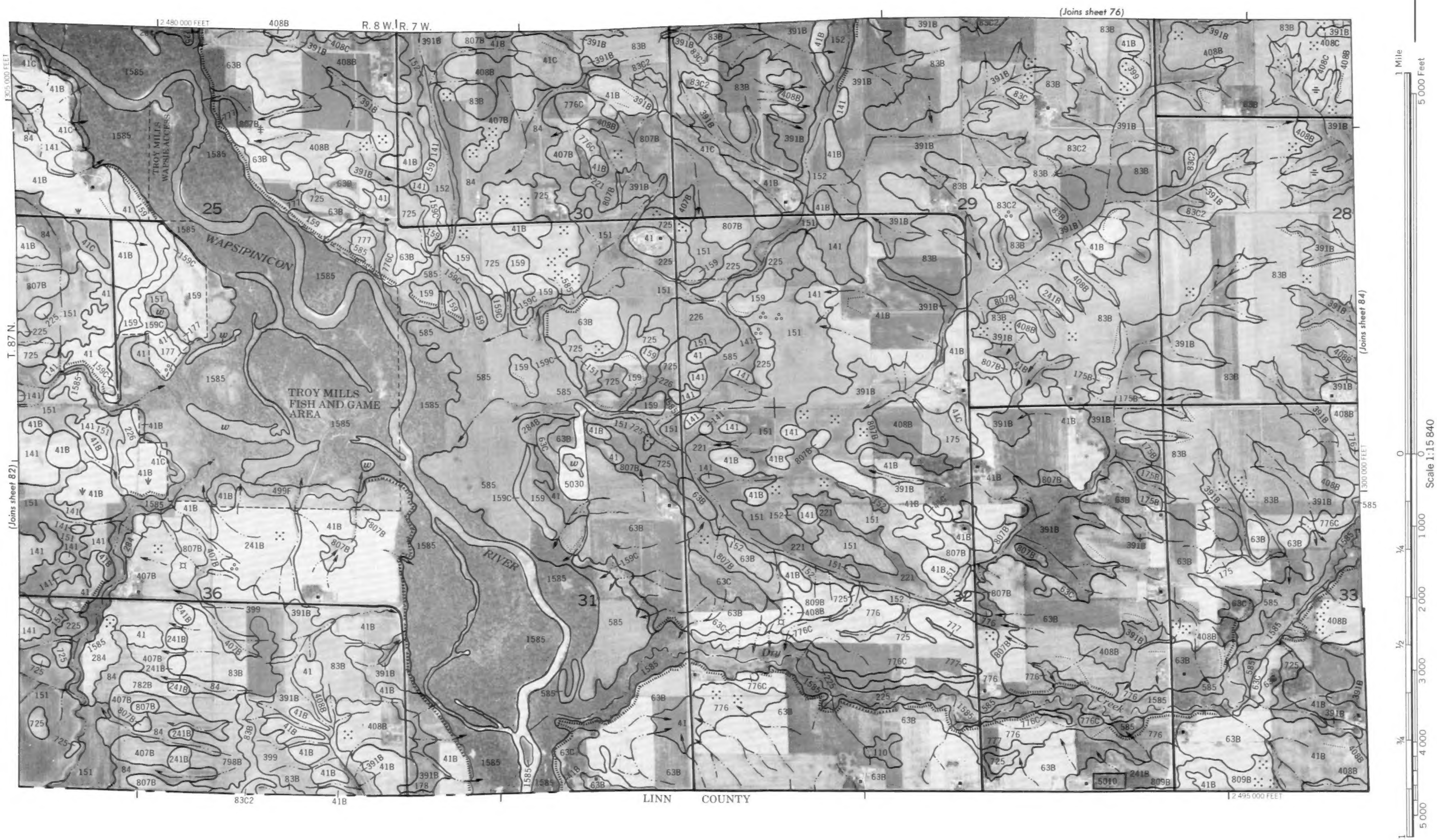

78
N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 71)
R 10 W
T. 87 N.
(Joins sheet 79)
BLACK HAWK COUNTY
BENTON COUNTY
CEDAR RIVER
Mud Creek
Lime Creek
Brandon
WATERLOO
RAILROAD
28
29
30
31
32
33

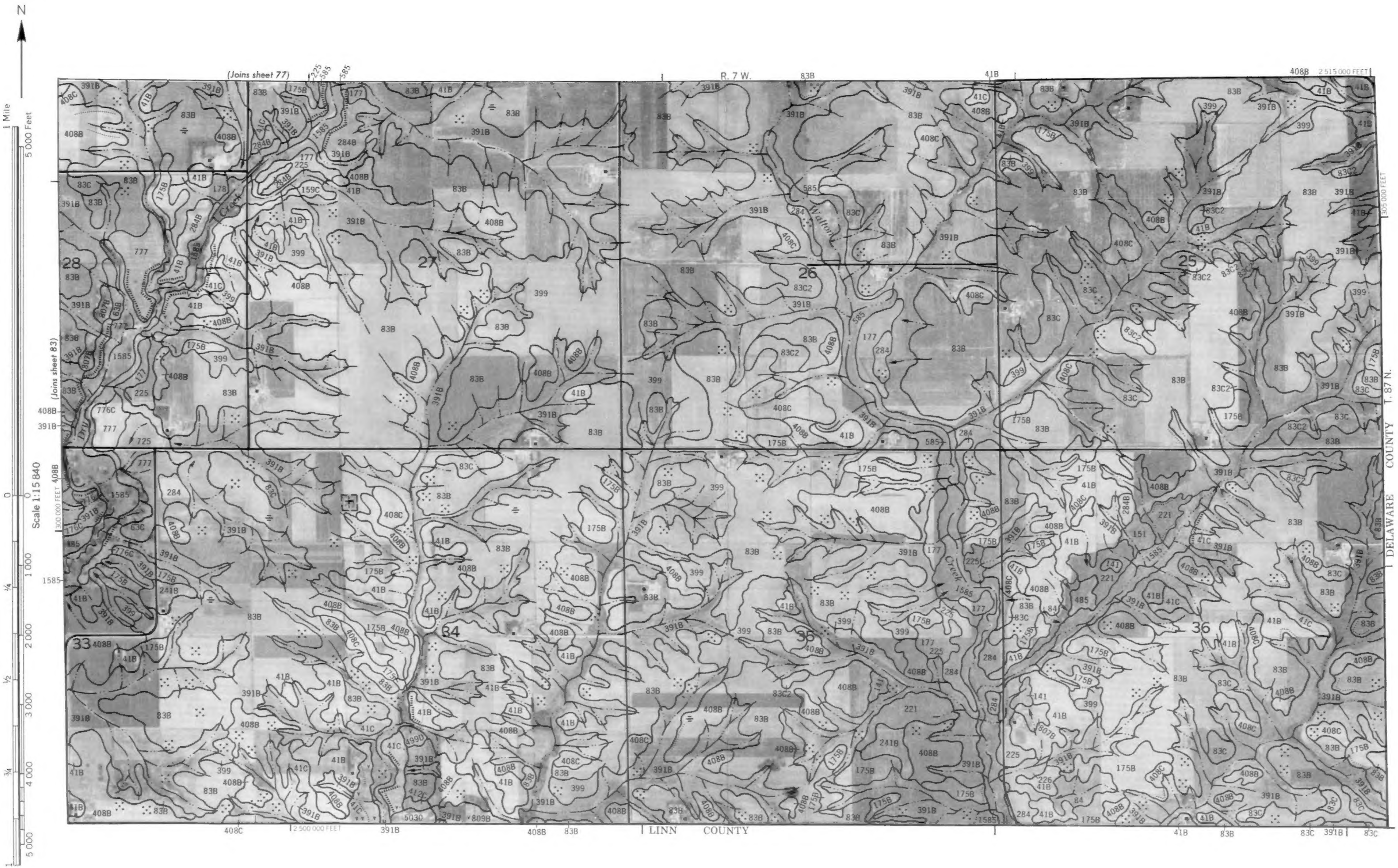

N
R. 10 W. | R. 9 W.
776C (Joins sheet 72)
T. 87 N.
(Joins sheet 78)
(Joins sheet 80)
Brandon
WATERLOO
Lime
Creek
Bear
Creek
RAILROAD
27
26
25
30
34
35
36
31
BENTON COUNTY
2 420 000 FEET
1 Mile
5 000 Feet
Scale 1:15 840
0
1000
2000
3000
4000
5000
¼
½
¾


N
(Joins sheet 73)
R 9 W.
T 87 N.
(Joins sheet 79)
(Joins sheet 81)
BENTON COUNTY
1 Mile
5 000 Feet
Scale 1:15 840
29
28
27
30
31
32
33
34


N
(Joins sheet 74)
(Joins sheet 82)
(Joins sheet 80)
R. 9 W. | R. 8 W.
T. 87 N.
2 445 000 FEET
2 455 000 FEET
315 000 FEET
300 000 FEET
BENTON COUNTY
LINN COUNTY
CHICAGO ROCK ISLAND AND PACIFIC
26
25
30
29
35
36
31
32
1 Mile
5 000 Feet
Scale 1:15 840


N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 75)
R. 8 W.
2 475 000 FEET
305 000 FEET
300 000 FEET
2 460 000 FEET
(Joins sheet 81)
(Joins sheet 83)
T. 87 N.
CHICAGO
ROCK ISLAND
AND
PACIFIC
LINN COUNTY
29
28
27
26
32
33
34
35


N
(Joins sheet 76)
(Joins sheet 84)
(Joins sheet 82)
R. 8 W. R. 7 W.
T. 87 N.
2 480 000 FEET
2 495 000 FEET
300 000 FEET
WAPSIPINICON
RIVER
TROY MILLS WAPSIE ACCESS
TROY MILLS FISH AND GAME AREA
Dry Creek
LINN COUNTY
25
30
29
28
36
31
32
33
1 Mile
5 000 Feet
Scale 1:15 840
0
1/4
1/2
3/4
1 000
2 000
3 000
4 000
5 000


N
1 Mile
5 000 Feet
Scale 1:15 840
0
1 000
2 000
3 000
4 000
5 000
¼
½
¾
1
(Joins sheet 77)
(Joins sheet 83)
R. 7 W.
T. 87 N.
DELAWARE COUNTY
LINN COUNTY
2 515 000 FEET
305 000 FEET
300 000 FEET
2 500 000 FEET
28
27
26
25
33
34
35
36
Dry
Creek
Walton
Creek